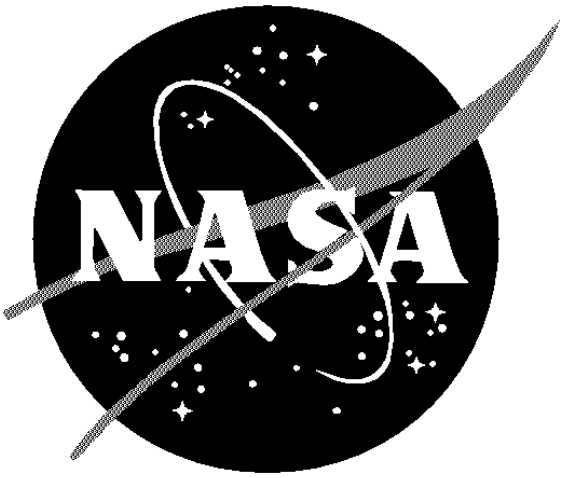


National Aeronautics and Space Administration

March 11, 1997

NRA-97-MTPE-02

RESEARCH ANNOUNCEMENT

THE EFFECTS OF TROPICAL FOREST CONVERSION: ECOLOGICAL RESEARCH IN THE LARGE-SCALE BIOSPHERE-ATMOSPHERE EXPERIMENT IN AMAZÔNIA (LBA)

Letters of Intent Due April 30, 1997
Proposals Due June 11, 1997

OMB Approval No. 2700-0087

THE EFFECTS OF TROPICAL FOREST CONVERSION: ECOLOGICAL RESEARCH IN THE LARGE-SCALE BIOSPHERE-ATMOSPHERE EXPERIMENT IN AMAZÔNIA (LBA)

NASA Research Announcement
Soliciting Research Proposals
for
Period Ending
June 11, 1997

NRA 97-MTPE-02
Issued March 11, 1997

Office of Mission to Planet Earth
National Aeronautics and Space Administration
Washington, DC 20546

THE EFFECTS OF TROPICAL FOREST CONVERSION: ECOLOGICAL RESEARCH IN THE LARGE-SCALE BIOSPHERE-ATMOSPHERE EXPERIMENT IN AMAZÔNIA (LBA)

I. PURPOSE OF THIS NASA RESEARCH ANNOUNCEMENT

This National Aeronautics and Space Administration (NASA) Research Announcement (NRA) solicits proposals for ecological research to be conducted as part of the Large Scale Biosphere-Atmosphere Experiment in Amazônia (LBA). The broad goal of this ecological research program is to improve our understanding of the effects of tropical forest conversion on ecosystem function and the sustainability of land use. The science question that will focus this study is:

> **How do tropical forest conversion, re-growth, and selective logging, influence carbon storage, nutrient dynamics, trace gas fluxes, and the prospect for sustainable land use in Amazônia?**

"Forest conversion" refers to forest clearing and conversion to agricultural uses, especially cattle pasture, and "forest re-growth" refers to forest growth following the abandonment of agricultural lands. The question calls for an explicit consideration of the effects of these land-cover and land-use changes on terrestrial carbon and nutrient budgets, the fluxes of trace gases between the land and the atmosphere, and the exchange of materials between the land and river systems. Implicitly, the question also calls for an understanding of these budgets, fluxes, and exchanges in "primary" or pre-disturbance forest ecosystems, and for an understanding of the social, political, and economic drivers of forest conversion and land use in Amazônia (Cerri et al., 1995).

This question identifies regional issues that are best addressed through an approach integrating field research, remote sensing, and modeling. It is directly relevant to NASA's Mission to Planet Earth goal of expanding scientific knowledge of the Earth system using NASA's unique capabilities from the vantage points of space, aircraft, and *in situ* platforms (NASA, 1996b).

Proposals for research that address this question are solicited in the general areas of carbon storage and exchange; nutrient dynamics; trace gas fluxes; dynamics of surface water chemistry; and land cover and land use change, including the human dimensions of land use change. Collectively, these five general research areas constitute the NASA ecological contribution to LBA, which, solely for the purposes of this announcement, will hereafter be referred to as LBA-Ecology.

The program of NASA-sponsored research covered in this announcement is intended to study the effects of tropical forest conversion and includes ecological research in LBA. Significant portions of the proposed research will be conducted within the territory of Brazil. The conduct of research activities sponsored by this announcement within the territory of Brazil is subject to and contingent upon approval(s) for such research activities by appropriate elements of the Brazilian Government. This NRA is being issued and proposals are being requested prior to the receipt of formal endorsement of and approval by the Brazilian Government of these proposed research activities. NASA is confident that the necessary Brazilian Government approvals will be obtained. However, NASA provides notice to all prospective offerors and potential investigators seeking to submit proposals pursuant to this announcement, that NASA reserves the right to make no selections and no awards for those research activities that do not receive endorsement and approval from the Brazilian Government. Subject only to the appropriation of funds, NASA

intends to make selections and awards for those research activities which do not require approval of the Brazilian Government, as well as for those research activities that receive endorsement and approval from the Brazilian Government.

II. BACKGROUND

A. Forest Conversion and Sustainable Development in Amazônia

The world's tropical forests are experiencing unprecedented rates of clearing and conversion to various forms of land use. Population growth and economic development efforts in tropical countries will ensure continued pressures to increase settlement within tropical forests and to utilize their resources. Of vital importance in developing sustainable management and exploitation systems for tropical forests are the questions of how much human activities affect the forests' basic capacities to renew themselves and of how to safeguard basic ecological processes such as biological productivity and the cycling of nutrients and water.

Recent remote sensing studies show that large areas of tropical forests in South America have been changed from forest to pasture or agricultural land (INPE, 1992; Fearnside, P. M., 1993; Skole and Tucker, 1993). Amazônia, a vast area of nearly 7 million square kilometers, contains almost one half of the world's undisturbed tropical evergreen forest and a large area of tropical savanna (Figure 1). Since the massive road-building efforts of the 1960's and 1970's, the Brazilian portion of the Amazon has experienced considerable development. Large areas of forest and savanna have been cleared and converted to cattle pastures or row-crop fields in several states including Mato Grosso, Pará and Rondônia. Selective logging has changed the structure and composition of forested areas, particularly in eastern Pará and along river courses.

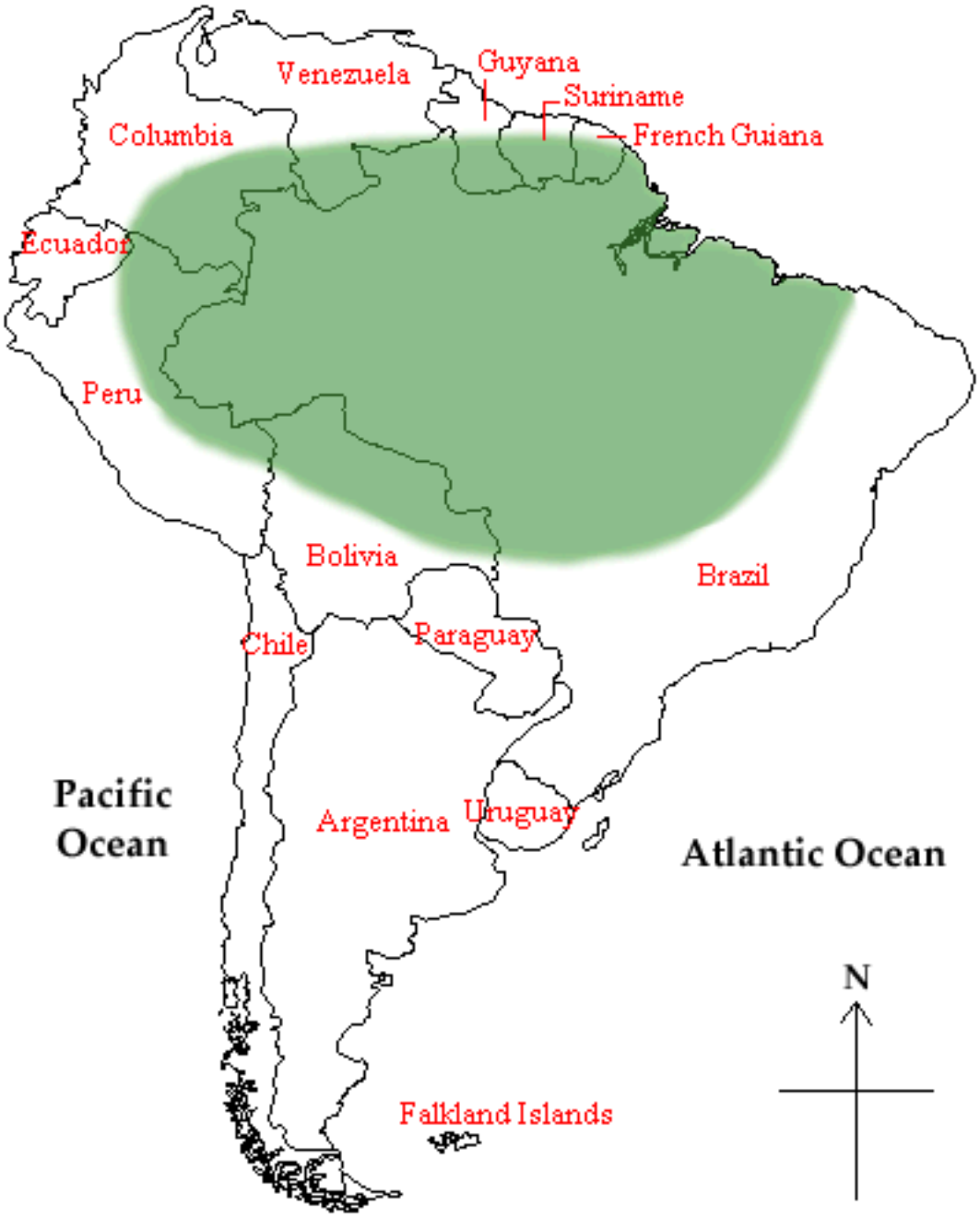
Based on the body of research to date (see references in Manaus Workshop Report: Cerri et al., 1995), we know that these activities have caused changes in carbon and nutrient budgets on land, the fluxes of gases between the land and the atmosphere, and the exchange of materials between the land and river systems. Additional research is needed to refine our understanding of the magnitudes of the changes and the controls on key biogeochemical processes in Amazônia's ecosystems. An understanding of these controls is essential for us to develop predictions of the consequences of changes in land cover and land use. All of these changes may have climatic, ecological, and environmental implications for the region, the continent, and the entire Earth system and, therefore, are of interest to the NASA Mission to Planet Earth (MTPE) research program.

B. Relevance to NASA’s MTPE Research Program

NASA’s MTPE focuses on studying how the global environment is changing. Using the unique perspective available from space, NASA observes, monitors, and assesses large-scale environmental processes. MTPE satellite data, complemented by aircraft and ground data, enable us to better understand environmental changes, to determine how human activities have contributed to these changes, and to understand the consequences of such changes. MTPE data and information, which NASA distributes to researchers worldwide, are essential to humans for making informed decisions about sustainable land use and environmental protection (NASA, 1996a).

MTPE's new Science Research Plan identifies Land Cover and Land Use Change (LCLUC) as one of five science priorities for the period 1996-2002 (NASA, 1996c). LBA-Ecology has been shaped to be responsive to this priority and will be focused to provide answers to specific questions about the effects of forest conversion that will provide a scientific basis for decision-making on sustainable land use in tropical ecosystems. NASA envisions LBA as a means toward advancing sustainable development in the region and, hence, furthering NASA's goal of enabling the productive use of MTPE science and technology in the public and private sectors (NASA, 1996b). LBA will strengthen ties between LBA science and regional institutions so that the knowledge generated by LBA can be used to address environmental issues that affect development in Amazônia.

Figure 1. The region referred to as Amazônia is highlighted on this base map of South America. Most of it lies within Brazil and is under the direct influence of the Amazon and Tocantins Rivers, but portions of Bolivia, Peru, Ecuador, Columbia, Venezuela, Guyana, Surinam, and French Guiana are also within Amazônia. Research may be proposed at any location within Amazônia, including regions of cerrado, although it is likely that the majority of the LBA-Ecology transect field work will be conducted within Brazil.



Seasonal-to-Interannual Climate Prediction is the only other MTPE science priority that LBA-Ecology directly addresses. LBA-Ecology will contribute to this priority through examination of seasonal and interannual variations in vegetation and ecosystem processes and their relationship to climate. There is a reasonable expectation that the effects of an El Niño-Southern Oscillation (ENSO) cycle might be observed during LBA-Ecology.

NASA has a long and successful history of using its unique capabilities to conduct remote sensing-oriented field research campaigns. LBA-Ecology will be next in the series of land surface/ecology field campaigns, following the Boreal Ecosystem-Atmosphere Study (BOREAS). The overall program of research for these campaigns includes a balance of field observations and experiments, aircraft- and space-based remote sensing, and modeling with emphasis on questions that can be effectively addressed though the use of airborne and satellite data.

The time-frame for LBA-Ecology will coincide with that for several major new national and international satellite missions (e.g., EOS AM-1, Landsat 7, TRMM) and opens opportunities for exciting new applications of remotely sensed data and collaborations with instrument science teams to evaluate new data products. LBA-Ecology can offer a well-characterized region and set of test sites, with abundant *in situ* and remote sensing data, for new sensor and data product evaluation. In turn, these new satellite missions can offer advanced data products to address LBA-Ecology goals.

C. LBA

LBA is an international research initiative led by Brazil. LBA is designed to create the new knowledge needed to understand the climatological, ecological, biogeochemical, and hydrological functioning of Amazônia, the impact of land use change on these functions, and the interactions between Amazônia and the Earth system. LBA is centered around two key questions that will be addressed through multi-disciplinary research, integrating studies in the physical, chemical, biological, and human sciences:

> How does Amazônia currently function as a regional entity?
>
> How will changes in land use and climate affect the biological, chemical, and physical functions of Amazônia, including the sustainability of development in the region and the influence of Amazônia on global climate?

In LBA emphasis is given to observations and analyses which will enlarge the knowledge base for Amazônia in six general areas: Physical Climate, Carbon Storage and Exchange, Biogeochemistry, Atmospheric Chemistry, Land Surface Hydrology and Water Chemistry, and Land Use and Land Cover. These are the LBA science "components" (see definitions of terms at end of Appendix A; note that these components cover a broader scientific area than do the science themes for LBA-Ecology). LBA is described in more detail in the 1996 Concise Experimental Plan (The LBA Science Planning Group, 1996; see Appendix F for URL).

LBA will be implemented as a group of complementary research modules (see definitions of terms at end of Appendix A), each with its own subset of goals and objectives and funding sponsor(s). LBA-Ecology, the subject of this NRA, constitutes one of these modules. The proposed Atmospheric Chemistry contribution, called Transport and Chemistry near the Equator - B (TRACE-B), and the proposed mesoscale catchment experiment are other such modules. The

plan for LBA is to conduct the research within these modules concurrently and to integrate them to the maximum degree possible through: (1) joint planning of the programs; (2) sharing of field sites, equipment, and logistical support; (3) exchange of data; (4) development of simulation models that couple the key physical, chemical and biological processes operating at various space and time scales in Amazônia, and (5) joint synthesis and scientific integration of results.

III. LBA-ECOLOGY: TYPES OF PROPOSALS REQUESTED

A. Scientific Scope of LBA-Ecology in Relation to LBA.

The NASA-sponsored ecological research within LBA (i.e., LBA-Ecology) will focus primarily on the forest conversion aspects of the second LBA question. This will include research activities within the following LBA components: Carbon Storage and Exchange, Biogeochemistry, Atmospheric Chemistry (ground-based and limited light aircraft-based observations only), Land Surface Hydrology and Water Chemistry (limited research into the dynamics of surface water chemistry only), and Land Use and Land Cover. However, it is expected that many of the observations to be made and analyses to be conducted under LBA-Ecology will contribute to addressing the LBA questions concerning climatic change and regional ecosystem function as well.

NASA may sponsor additional research under the Atmospheric Chemistry, Physical Climate, and Land Surface Hydrology components of LBA. If so, such opportunities in these other areas will be announced in future NASA research announcements.

B. Planning for LBA-Ecology.

The planning for a study of the ecological and biogeochemical consequences of land use and land cover changes in the Amazon has been underway since the early 1990's. Scientists from institutions in the U.S., Brazil, other South American countries, and Europe participated. The key institutions involved were Instituto Nacional de Pesquisas Espaciais (INPE), NASA, Instituto Nacional de Pesquisas da Amazônia (INPA), and the Centro de Energia Nuclear na Agricultura (CENA) da Universidade de São Paulo (USP).

Plans for LBA-Ecology were developed through a series of workshops and steering committee meetings. The key workshops were: September, 1993, Brasilia, Brazil (which developed the "AMBIACE" and "TAHBIS" concepts joint with atmospheric chemists and resulted in a series of papers in *Revista Brasileira de Geofísica* (Kirchhoff, 1994; Wofsy et al., 1994)); May, 1994, Piracicaba, Brazil; May, 1995, Manaus, Brazil (which resulted in the Manaus Workshop report: Cerri et al., 1995); and December, 1995, Cachoeira Paulista, Brazil (which resulted in the Remote Sensing Workshop report: Hall et al., 1996). Aspects of LBA-Ecology can also be traced to the early “LAMBADA-BATERISTA” workshops (Sellers, et. al., 1992).

The Manaus Workshop Report (Cerri et al., 1995) is the most detailed and definitive description of the ecological goals, research questions, and activities underlying the LBA-Ecology module (see Appendix F for URL). The Remote Sensing Workshop Report (Hall et al., 1996) provides similar background for the remote sensing goals, research questions, and activities underlying remote sensing in LBA as a whole (see Appendix F for URL). Both cover a broad range of science requirements and research activities consistent with the LBA-Ecology science question, but do not

provide a research strategy or set priorities. This announcement attempts to provide the strategy and priorities. In addition, five synthesis papers were developed as a result of the Manaus workshop and are now in press in *Ciencia e Cultura* (Fernandes et al., 1997; Keller et al., 1997; Nepstad et al., 1997; Richey et al., 1997; and Houghton, 1997).

LBA-Ecology has its roots in past work conducted under the auspices of NASA's Amazon Ground Emissions (AGE) study, the 1991 NASA Tropical Carbon Cycling initiative, NASA's Global Troposphere Experiment (GTE) program (including ABLE-2A and -2B and TRACE-A), the more recent Smoke, Clouds and Radiation - Brazil (SCAR-B) study, and many other programs sponsored by other national and international organizations. It has been emphasized during the planning that LBA-Ecology must build upon the results of this body of past work. Activities to integrate data and synthesize past results have been part of LBA planning to date (e.g., the 5 synthesis papers), and more such work will be required during the early phase of LBA.

Inspiration for the science objectives and research design was derived from several International Geosphere-Biosphere Programme (IGBP) Core Project plans, including Global Change and Terrestrial Ecosystems (GCTE) (Steffan, et al., 1992), primarily Focus 1 (Ecosystem Physiology) and Focus 2 (Change in Ecosystem Structure); International Global Atmospheric Chemistry (IGAC) Project (Pszenny and Prinn, 1994), primarily Biosphere-Atmosphere Trace Gas Exchange in the Tropics: Influence of Land Use Change (BATGE); Biospheric Aspects of the Hydrological Cycle (BAHC) (BAHC Core Project Office, 1993), primarily Focus 2 (Regional-Scale Studies of Land-Surface Properties and Fluxes), but also Foci 1 and 3; and, especially, the IGBP Terrestrial Transects Science Plan (Koch et al., 1995) and the new IGBP/International Human Dimensions Programme (IHDP) Land-Use and Land-Cover Change (LUCC) Core Project (Turner, et al., 1995), primarily Foci 1 and 2. At the First IGBP Congress in April, 1996, LBA as a whole was identified as a candidate to become an new type of IGBP research activity, called an "Interproject," because of its broad interdisciplinary nature and multi-national scope (Lunter, 1996).

LBA-Ecology has been designed specifically to provide a significant portion of the research necessary to implement the Humid Tropical Forest Transect in the Amazon Basin called for in the IGBP Terrestrial Transects Science Plan (Koch et al., 1995).

LBA-Ecology is a contribution to the U.S. Global Change Research Program (NSTC, 1996).

Planning for LBA-Ecology also has been conducted in parallel with that for the scientific research agenda of the Inter-American Institute for Global Change Research (IAI) (Grove, 1995a; Gentile, 1996), and the scientific priorities identified by each have influenced the development of the other. LBA addresses many of the scientific priorities of the Tropical Ecosystems and Biogeochemical Cycles research theme of the IAI (Grove, 1995b). It is anticipated that LBA also will work closely with IAI on training and educational activities.

C. Resources Available from NASA

NASA's Terrestrial Ecology (TE) Program and Land Cover and Land Use Change (LCLUC) Program plan to select and fund approximately 35 proposals to conduct LBA-Ecology investigations that will address the research questions and activities identified in this announcement for a period of up to 3 years, with annual progress reporting and internal review. After 3 years, there will be an option to submit a new proposal for full external review and renewal, with annual

progress reporting and internal review, for up to another 3 years. A total of approximately $6 million per year will be made available for LBA-Ecology, with additional funding possible for a future major remote sensing aircraft deployment to South America. NASA expects to carry out this project within current guidelines for the MTPE research and analysis program without any enhancements to those funds.

Approximately $1 million per year is available from the NASA LCLUC Program to address the research on land cover and land use change described in Section III-E-1, III-F and elsewhere below. Approximately 5-10 investigations will be funded. The intention to support this work in LBA was announced in NRA-96-MTPE-03 where it was stated that Amazônian studies would not be entertained under that NRA, but would be sought through a subsequent joint solicitation with the NASA TE Program. This NRA is the joint solicitation with the NASA TE Program seeking LCLUC studies in Amazônia. NRA-96-MTPE-03 and the newly revised MTPE Science Research Plan (NASA, 1996c; see Appendix for URL) may be consulted for additional information about the scope and initial priorities of the LCLUC Program.

Approximately $5 million per year is available from the NASA TE Program to address research in all areas described in Sections III-E (including land cover change) and III-F and elsewhere below. This sum includes Project Office support. Approximately 30 investigations will be funded. It is anticipated that an intensive field study involving continuous monitoring might cost $300,000 or more per year, but that some modeling, data compilation, or remote sensing data analysis studies might cost less than $100,000 per year.

D. Research Approach for LBA-Ecology

The LBA-Ecology science question is:

> **How do tropical forest conversion, re-growth, and selective logging, influence carbon storage, nutrient dynamics, trace gas fluxes, and the prospect for sustainable land use in Amazônia?**

NASA has chosen to address this question not so much because a basic, comprehensive field campaign will systematically advance our understanding of this important global change topic, but rather because the international scientific and remote sensing research community appears to be poised to make major break-throughs in providing a more comprehensive and integrated understanding of land use change in Amazônia. Major advances can be achieved through research combining existing knowledge; numerous existing, but dispersed, data sets; robust ecological models; and new remote sensing and data analysis technologies that have been developed by NASA and its international space agency partners. The results of past remote sensing studies of land cover and several field campaigns in Amazônia are ready to be exploited. New data analysis approaches and tools are becoming available, and the next generation of satellite sensors, with fundamentally new capabilities, are about to fly. While some of the *in situ* and remote sensing observations and data sets needed for LBA-Ecology may seem routine, the uses to which they will be put should not be! Other observations and data sets to be used will be brand new. *NASA is seeking new research and new analytical approaches under LBA-Ecology that will build upon past results to extract new understanding of the effects of forest conversion, that will provide a whole system synthesis, that will employ innovative analytical approaches combining data sets from multiple sources and/or linking across spatial and temporal scales, and that will*

aggressively and creatively take advantage of new remote sensing observations as they become available.

The LBA-Ecology Science Team will need to pursue an integrated approach involving synthesis of past research results and data sets, modeling, remote sensing, Geographic Information System (GIS)-based analyses, new field observations and process studies, training and education, and synthesis and integration of new results in order to tackle the LBA-Ecology science question. The challenge of addressing integrated ecosystem responses in a regional context and the imperative to produce results that can be useful to decision-makers require that a strategic, rather than a comprehensive, approach to LBA-Ecology scientific endeavors be pursued. LBA-Ecology cannot attempt to measure every important ecosystem property and/or process in all representative land cover types nor can it afford to repeat past work. If LBA-Ecology is to succeed in answering some or all of the questions posed below in Section III-E, past work in Amazônia must be exploited to the fullest, on-going research (under various sponsors) must be engaged, and new activities must be carefully selected and directed to fill the most critical of gaps and/or to gain the most leverage on major scientific uncertainties. *Investigators proposing in response to this announcement should specifically address the importance of their work in filling major gaps and reducing critical scientific uncertainties. They should also take care to be explicit in putting their proposed research into the context of what is already known and in explaining how it builds upon past research. Creative, innovative, synthetic approaches should be emphasized.*

Planning to date has specified a preliminary field sampling design involving 2 large transects (see Appendix A) that captures the range of variability necessary to address the LBA-Ecology question while constraining the geographic dispersion of new intensive field study sites. The 2 transects span land use intensity and climatic gradients in regions of the Amazon where forest conversion or selective logging have been major factors in shaping the landscape. Along the transects there will be a few primary and secondary research sites (at least 3 per transect -- one at each end and one near the middle) and many more extensively distributed auxiliary research sites. The primary sites will be based on clusters of 2-4 flux towers. The tower clusters incorporate a local-scale gradient of land use, providing observations and process studies in each of the predominant land use types (e.g., primary forest, pasture or cropland, secondary forest, selective logging) at that location along the transect. Secondary sites (which may include flux towers provided by other LBA modules) will help to complete the climate gradients. This LBA-Ecology two-transect field design is dependent on contributions from other LBA modules; the only way a full complement of towers can be deployed to adequately define both transects will be though cooperation, coordination, and effective sharing of infrastructure across all modules of LBA.

Continuous, near-continuous, or intermittent observations of a core set of measurements (e.g., CO_2 fluxes, trace gas fluxes, trace gas concentrations, micrometeorological conditions, radiation, aerosols, vegetation properties, soil properties) will be made at the primary field sites over a period of 3-5 years. Additional observations and process studies, including manipulative experiments and chronosequence studies, will be conducted at the primary sites and at secondary and auxiliary sites along the two transects.

Time series of satellite observations of Amazônia as a whole and of the sites along the 2 transects will be obtained for LBA. Data from most past and current sensors will be exploited, with Landsat, AVHRR, SPOT, and JERS-1 being the primary sources of data and SSM/I, ERS-1/2, and Radarsat providing supporting data (see acronym list in Appendix A). Close interactions with the AVHRR and Landsat Pathfinder projects and with INPE's Amazônian program are anticipated

in developing data sets on past and present land cover change. LBA will be in a position to benefit from a wide variety of new sensors on several satellites scheduled for launch in 1997-1999; these satellites include TRMM, EOS AM-1, Landsat 7, CBERS, ENVISAT, and ADEOS II. Planning and preparation for the utilization of this new data stream will be important during the first 2-3 years of LBA, and extensive analysis will be a major emphasis for LBA-Ecology in the years thereafter. Light aircraft may be flown at regular intervals to acquire basic remote sensing data and to measure water, energy, and carbon dioxide fluxes at the primary and secondary research sites.

These longer-term *in situ*, light aircraft, and satellite-based studies will be augmented by brief, intensive observational campaigns involving use of larger research aircraft and other instruments or capabilities that can only be fielded for short periods of time due to logistical difficulties and/or expense.

Modeling will be conducted at all stages of the study and will address a hierarchy of spatial and temporal scales. In the beginning, models will be used to refine the study design and to identify problem areas within specific models or limitations in data sets and process-level understanding that may need to be addressed before the models can be applied usefully to Amazônian systems. Throughout the study models will be used to capture and test understanding, extend observations and understanding from local to regional (and occasionally global) scales, and predict future ecosystem responses based on scenarios of change.

LBA-Ecology will incorporate a multi-scale perspective focused on achieving understanding of the effects of forest conversion at scales ranging from the local site-level scale to that of the entire Amazônian region. Local-scale measurements and process understanding, in combination with remotely sensed data and GIS data layers, will be used to develop and validate regional-scale models. Research will be conducted to develop and apply new methods (e.g., remote sensing, scaling, data assimilation) that can be used to integrate system component models into large-scale simulation models.

E. LBA-Ecology Science Themes

The LBA-Ecology science question requires research under five major science themes: 1) land-cover and land-use change, 2) carbon storage and exchange, 3) nutrient dynamics, 4) trace gas fluxes, and 5) dynamics of surface-water chemistry. Subsidiary research questions have been identified under each of these themes (see also Cerri et al., 1995). The number of awards in LBA-Ecology across these five themes will not be equal. Changes in land use and carbon dynamics will receive particular emphasis. Studies of the dynamics of water chemistry will be limited to on-going (already funded) research and a few new tasks to interrelate the nutrient dynamics of a site with its hydrological dynamics -- which will be investigated by other LBA modules. The research activities that are detailed in Section III-F cross-cut these 5 science themes; it is expected that most, if not all, of those activities will be necessary to the conduct of research under each of the 5 science themes.

1. Land-Cover and Land-Use Change. Land-cover and land-use change research conducted in LBA will emphasize the following issues: 1) linking the spatial and temporal dynamics of patterns of land-cover change with analyses of the underlying proximate, intermediate, and ultimate determinants of land-use change; 2) developing new diagnostic and prognostic models of land-cover and land-use change with direct coupling to feedbacks from biophysical processes provided

by other components of LBA research; 3) developing an improved understanding of spatial and temporal scaling, from the farmer to the basin scales; and 4) developing analyses defined in the IGBP/IHDP LUCC Science Plan (Turner et al., 1995) for Focus 1 and Focus 2, leading to regional integrated development of systems models. The following questions are to be addressed:

> **What are the rate and spatial extent of deforestation for agriculture and logging in the Amazon and how might they progress over the next 20 years? (What is the annual rate of change? What are the transition dynamics of deforestation and recycling of secondary growth? How can we empirically analyze and develop new models of the deforestation process?)**
>
> **What land-use and land management strategies are found in the Amazon, and how do they control or interact with the dynamics of ecosystem response to disturbance? (What land-use strategies determine the abundance and distribution of secondary growth, and how do they determine the balance between clearing and re-growth? What feedbacks from changes in ecological conditions influence these land-use strategies?)**
>
> **Within a given Amazônian landscape, how do land tenure and management influence the spatial topology of primary and secondary land covers and biological diversity? (How do changing patterns of consumption, including "customary use", influence the biological diversity in adjacent forests, and how do changing patterns in population density influence the spatial topology of primary, secondary, and actively managed lands?)**

The issues of tropical forest conversion in Amazônia and its consequences underlie these questions and provide the central focus for all of LBA-Ecology. Tropical forest conversion to agricultural uses, selective logging activities, and secondary re-growth are significantly altering the landscape of Amazônia and represent one of the most profound global change phenomena of the present day. Concerns about the sustainability of land-use, the capacity of Amazônian ecosystems to maintain basic functions and provide ecological goods and services, and changes in greenhouse gas emissions and the oxidative capacity of the atmosphere have generated a pressing need to document changes in Amazônian land-cover and land-use, to understand the social, economic, and political factors that control land-use change, and to predict future consequences.

Two scales of investigation are envisioned: basin-wide (macro) studies and analyses, and specific site and case studies (micro). Sites discussed at the Manaus Workshop Report (see Figure 3 in Appendix A) would be appropriate, although not specifically required in response to this NRA. Research activities of special interest for this solicitation include: 1) measurements of land-cover change and its spatial pattern at less than 100 m resolution over the whole basin using synoptic satellite measurements of deforestation and secondary growth; 2) sample-based measurements of land-cover change for the whole basin using stratified sampling methods to define the annual variation in rates of change between the synoptic inventories; 3) Amazônia-wide coupling of sociodemographic (including migration), agricultural, and econometric data at the municipio level for a suite of specific variables in order to develop land-use change variable sets; 4) establishment of a suite of site-specific (~100 x 100 km) multi-temporal (annual) satellite analyses of land-cover change transition dynamics to define the transition probabilities and analyses of dynamics of secondary growth turnover; 5) field-based analyses of the decision-making processes for farmers and other land-managers, using established techniques in community survey; 6) analyses of the

spatial pattern and geometry of land-cover changes, which provide information on landscape patchiness and fragmentation, and are vitally important to evaluations of effects on biodiversity and ecosystem function; and 7) enhanced description of the community structure in natural land-covers and in the disturbed matrix of land-covers, including analyses of the dynamics of community structure through sequences of recovery and secondary succession.

As a very rough estimate, approximately $1,500,000 per year will be allocated for studies of land cover and land use change ($1,000,000 from LCLUC and $500,000 from TE).

2. Carbon Storage and Exchange. Research on the terrestrial carbon budget will involve quantification of the magnitude of the carbon pools in vegetation and soils of intact forests and savannas, pastures, cultivated lands, and second-growth and selectively-logged forests. It will also involve quantification of the rates of carbon exchange among the atmosphere, vegetation, and soils, and of the ways these rates are altered by natural and human disturbances. The following questions are to be addressed:

> **What are the sizes of the carbon pools in the vegetation and soils of intact, secondary, and selectively-logged forests, savannas, and agricultural lands?**
>
> **What are the net rates of carbon exchange between the atmosphere, vegetation, and soils? What are the relative contributions of fluxes from natural and disturbed ecosystems to the net basin-wide flux? (To what degree do natural sinks and sequestration of carbon in re-growing forests balance or offset sources associated with deforestation and selective logging?)**
>
> **How will changes in land use affect the net carbon balance (i.e., size of the pools and the rates of exchange) between terrestrial ecosystems and the atmosphere in Amazônia?**
>
> **What is the seasonal and interannual variability of the carbon dioxide flux between the atmosphere and different land-cover/land-use types and from the Amazon region as a whole?**

The major issues and uncertainties underlying these questions relate to 1) Amazônia's contribution to the global carbon budget (is it a source or a sink for carbon?), 2) how this contribution is being, and will be, altered by changes in land cover and land use, and 3) how changes in carbon stores and fluxes brought about by land use change and varying management practices impact the sustainability of agriculture in the region. It is desired to conduct analyses that will aid Amazônian nations in meeting Climate Convention requirements. A need to better understand the influences of climatic variability on seasonal and interannual variability of carbon dynamics also motivates these questions.

Methods to be considered for estimates of carbon stocks include destructive sampling, annual re-visits to measure change, and advanced remote sensing techniques. Methods to be considered for carbon flux estimates include aircraft- and tower-based eddy correlation, chamber-based measurements, and soil, plant, and water biogeochemical assays. Chronosequences of pasture age or time since a change in management practice and manipulative experiments may be conducted. Remote sensing approaches to quantify biomass or re-growth stages in secondary forests may be explored. Process-based modeling of carbon exchange will be necessary. Models, combined with

GIS and remotely sensed information, may be used to provide estimates of regional exchange of carbon. Analyses of multi-year data sets to characterize seasonal and interannual variability of carbon dynamics may be conducted. It is anticipated that regional carbon balance and climate variability studies will be LBA-wide research endeavors, with contributions from all science components and funded modules.

As a very rough estimate, approximately $2,000,000 per year will be allocated for studies of carbon storage and exchange.

3. Nutrient Dynamics. Research on plant and soil nutrient dynamics will involve quantification of the magnitude of the nutrient pools in vegetation and soils of intact forests and savannas, pastures, cultivated lands, and second-growth and selectively-logged forests. It will also involve quantification of the rates of nutrient cycling within the system and of the ways these rates are altered by natural and human disturbances. Nitrogen and phosphorus are nutrients of major interest. The following questions are to be addressed:

> **How do the stocks, cycling rates and budgets of nitrogen, phosphorus, potassium, calcium, magnesium, and aluminum change under the different land covers and land uses?**
>
> **What are the major factors that control the sustainability of agricultural productivity and the rates of re-growth and carbon accumulation in abandoned pastures and re-growing secondary forests?**

The major issues and uncertainties underlying these questions relate to the effects of forest conversion and land use practices on soil fertility and the long-term sustainability of agriculture in Amazônia. Land use changes of interest are forest conversion to pasture, selective logging, slash and burn agriculture, pasture degradation and abandonment, secondary re-growth, and conversion of cerrado to pasture and row crop agriculture. Of particular interest are changes in the exchanges of nutrients among the soils, vegetation, atmosphere, and river systems of Amazônia that occur as agricultural lands age and/or degrade and abandoned lands recover or enter into repeating cycles of use, abandonment, and re-growth.

Measurements and process studies to be conducted for nutrient cycling are very analogous to those to be made for carbon, and in most cases they should be conducted together. Standard methods (see Cerri et al., 1995) should be utilized to measure stocks and fluxes of nutrients, and process studies to understand the important environmental controls on them should be conducted. Chronosequence studies and experiments involving amendments may be conducted. Investigations to identify agricultural practices that are more beneficial ecologically or have potential for long-term sustainability may be conducted. Studies of the effects of fire may be conducted. Modeling of nutrient dynamics is expected. Remote sensing approaches to assess site conditions and/or ecosystem vigor may be explored.

As a very rough estimate, approximately $1,000,000 per year will be allocated for studies of nutrient dynamics.

4. Trace Gas Fluxes. Research on trace gas fluxes will focus on quantification of the fluxes between the terrestrial biosphere and the atmosphere and determination of how various factors control these fluxes. First priority will be given to studies of nitrogen oxides and methane for

which natural and managed systems in the Amazon constitute a significant global source. In addition to its contributions to the goals of LBA-Ecology, this trace gas flux research will provide a significant foundation for a potential aircraft-based expedition, called TRACE-B, that is currently being planned by the Tropospheric Chemistry Program at NASA and by other atmospheric chemistry programs. The TRACE-B plan requires that certain LBA-Ecology *in situ* monitoring observations be initiated at least a year in advance of the aircraft expedition; thus this module will only be proposed to Brazil after the LBA-Ecology observations have begun, and, of course, will be subject to successful implementation of an agreement between NASA and Brazil for TRACE-B and securing all necessary host country approvals. In order to prepare to support TRACE-B, LBA-Ecology will include measurements of concentrations and fluxes, with associated data analysis, of additional chemical constituents important to the LBA Atmospheric Chemistry goals. The following questions are to be addressed:

How are the fluxes of trace gases between ecosystems (both uplands and wetlands) and the atmosphere of Amazônia affected by forest conversion and land use?

How does land use change affect the atmospheric oxidant balance in Amazônia? (joint with Atmospheric Chemistry)

The major issues and uncertainties underlying these questions relate to the effects of forest conversion in Amazônia on global atmospheric greenhouse gas budgets and the oxidative capacity of the atmosphere. Addressing these issues also will aid Amazônian nations in meeting Climate Convention requirements. Equally important, is the desire to quantify the losses of nutrients from plants and soils and their relationship to sustainable agriculture.

Methods to be considered include use of enclosures or chambers for rapid measurements of long-lived and some reactive gases from soils, analysis of flask samples for atmospheric chemical concentrations, and vegetation and micrometeorological methods for continuous or regular measurements of many trace gases. Experimental manipulations and/or isotope tracers could be used for studies of mechanisms controlling trace gas production and emission. Studies of changes in trace gas fluxes that follow fire may be conducted, primarily when fire is used to manage agricultural lands, but also as a naturally occurring process in forests and cerrado. Remote sensing analyses to characterize land cover, especially spatial extent and temporal duration of inundation, should be conducted. Process-oriented models of trace gas fluxes are desired, as are models to provide estimates of regional exchanges.

Surface-based observations that would support the proposed TRACE-B aircraft expedition's goals should focus on determining the concentrations of key reactive and greenhouse gases and aerosols at the surface and defining the primary influences on those concentrations. Indicators of biomass burning (e.g. CO, acetylene) and industrial activity (e.g., CFCs, other halocarbons) should be measured along with key reactive species, biogenic reactive hydrocarbons, and greenhouse gases. Budget studies may be possible using atmospheric transport models and ground-based or aircraft-based measurements. It is anticipated that for mesoscale and regional studies this work will be conducted in collaboration with the Atmospheric Chemistry module and possibly other modules of LBA.

As a very rough estimate, approximately $1,200,000 per year will be allocated for studies of trace gas fluxes.

5. Dynamics of Surface-Water Chemistry. Research in this area will focus on the ways in which surface water chemistry is altered by land-cover and land-use change. Changes in the dynamics of carbon, nitrogen and phosphorus along gradients from well-drained uplands through wetlands, riparian zones, and streams are of particular interest. The following question is to be addressed:

> **What are the changes in the pathways and fluxes of organic matter, nutrients, and associated elements through river corridors (riparian, floodplain, channels, wetlands) as a function of land cover and land use change?**

The major issues underlying this question relate to 1) understanding the pathways of carbon and nutrient loss from agricultural lands and selectively logged forests through terrestrial drainage basins into wetlands and river systems and 2) accounting for subsequent changes in the fluxes of radiatively and chemically important trace gases to the atmosphere from impacted wetlands and river systems.

LBA-Ecology seeks only very limited new research tasks in the dynamics of surface water chemistry. It is believed that on-going research funded by other sponsors can provide much of the observations and understanding necessary to address the LBA-Ecology questions in this area. Thus, this announcement seeks to attract the investigators conducting those investigations to propose for participation in LBA-Ecology. In addition, modest funding may be made available to ensure that LBA-Ecology nutrient dynamics research is appropriately linked to the hydrological research to be conducted under other LBA modules (in particular, the mesoscale catchment experiment) and that fluxes of carbon and nutrients into surface waters and their fate are appropriately considered.

Any LBA-Ecology work on the dynamics of surface water chemistry will be dependent on the detailed plans, infrastructure, and timing for the LBA hydrology and/or mesoscale field experiment modules -- which are not yet settled. For planning purposes, investigators proposing under the LBA-Ecology dynamics of surface water chemistry theme should assume that these hydrological modules will start full field operations in 1999.

As a very rough estimate, approximately $300,000 per year will be allocated for studies of the dynamics of surface water chemistry.

F. Types of Activities in LBA-Ecology

The activities listed in this section cross-cut the science themes detailed in Section III-E above. Each of these activities is relevant to most, if not all, of the science themes. In Section III-E, approximate levels of funding for each science theme were specified; these amounts sum to the total amount of funding available (see Section III-C). In this section approximate numbers of awards in each type of activity are estimated; these, too, sum to the total approximate number of awards to be funded. It is anticipated that many proposals will address more than one science theme and most proposals will include more than one type of activity; thus, a one-to-one mapping of funds and numbers of awards in both sections seems problematic and has not been attempted.

All research under LBA-Ecology will be expected to quantify errors and uncertainties associated with data, analytical approaches, and scientific interpretations.

The following types of activities are requested:

1. Synthesis of Past Work. Research to evaluate, integrate, and summarize the results of past research on carbon dynamics, nutrient cycling, trace gas fluxes, and the effects of forest conversion in Amazônia is needed. It is expected that most proposals will address this requirement as a component of the overall research approach, but that a few proposals might offer work wholly dedicated to reviewing past work and providing a synthesis of current understanding. All such proposals must demonstrate how the review and synthesis to be provided will help address one or more of the questions enumerated in Section III-E.

Existing data sets from public archives and from past research in Amazônia must be accessed and prepared for use by LBA investigators. It is likely that new data sets will need to be compiled to meet the needs of modelers. Other data sets may need to be re-analyzed. Proposals to provide, compile, re-analyze, and/or synthesize existing data sets are sought. All of these proposals must include a data analysis and management component focused on addressing one or more of the questions enumerated in Section III-E.

NASA plans to fund approximately 1-3 new awards dedicated to review and synthesis of past work. It is expected that many more of the proposals to be selected will include such work as one component of a study focused on other research activities.

2. Geographic Information System (GIS) Development. LBA spans a hierarchy of spatial scales. At the largest scale, that of the entire region of Amazônia, a database will be created to include many forms of survey data, both environmental and socio-economic, and remote sensing imagery. These will be organized into a community GIS. This database will be available to all LBA scientists and used for direct analysis of relationships among data layers and to drive models of all sorts (e.g., ecological, hydrological, climatological, socioeconomic, GCMs) that will endeavor to capture basin-wide system function and explore scenarios of future change for LBA. LBA-Ecology will contribute appropriately to the database development and synthetic and integrative science in this area and will take the lead on developing the human dimensions data on land use change for inclusion in the database.

Proposals to make available and/or assemble existing and/or newly acquired data sets and data layers for the GIS are sought. All such proposals must include a data analysis and management component focused on addressing one or more of the questions enumerated in Section III-E of this announcement. This research will need to be conducted in close consultation with the LBA Science Team and Project Staff. Some work on such data sets is already underway by Project staff with the goal of providing a "pre-LBA" CD-ROM in 1997. The current plan is for these data sets to be made publicly accessible through the LBA Home Page as soon as they become available. Future work on design and development of such data sets and a GIS will be conducted jointly by the overall LBA Science Team and Project Staff; the exact details of who does what will be determined once the results of this solicitation and other LBA selection processes are known.

NASA plans to fund approximately 2-4 new awards dedicated to the development of GIS data layers and/or the LBA-Ecology GIS. It is expected that other proposals to be selected may include work on a GIS data layer as one component of a study focused on other research activities.

3. Modeling. Modeling is a powerful tool for interpolating and extrapolating observations and process understanding as well as for testing understanding of the modeled linkages of processes within the system and among ecosystems in a landscape. Proposals are requested for modeling research to: 1) identify limitations in data and/or process understanding or to generate predictions that can be used to refine the LBA-Ecology study design, 2) identify and resolve problem areas within specific models that may need to be addressed before they can be applied usefully to Amazônian ecosystems, 3) capture and test understanding derived from LBA-Ecology local-scale process studies, 4) scale LBA-Ecology observations and understanding from local to regional (and possibly global) scales, 5) predict future ecosystem responses based on realistic scenarios of change, and 6) model the process of land use change and predict future patterns. Models that operate at differing spatial (e.g., site or stand to entire Amazônian region) and temporal (minutes to centuries) scales are needed. Use of measurements and process understanding to develop and validate process-oriented models of system components is needed to address the research questions relevant at both local and regional spatial scales.

Research to generate Amazônia-wide estimates of net carbon exchange and of how it varies with changes in land cover and land use will be an important goal for LBA-Ecology and for LBA as a whole. Modeling investigations to achieve this objective are strongly encouraged (as are other approaches). It also may be possible to generate regional estimates of net exchanges of certain nutrients, trace gases, and/or particulates as well; and well-conceived modeling investigations to address other such regional budgets will be welcome. Models that capture the effects of land use change and differing agricultural management practices on soil fertility, the sustainability of agricultural production, and ecosystem function and fragmentation at local or regional scales are encouraged.

Proposals for models of the land-cover and land-use change process are encouraged. NASA anticipates that such models may initially be empirical, perhaps taking the form of Markov chain models coupled with econometric and/or demographic data, or various kinds of regression models. However, there is also the anticipation that even initially empirical models will evolve towards more process-based formulations, so that there is the prospect during the LBA study, of performing sufficient sensitivity analyses or scenario-based analyses that the consequences of different patterns of future land-use change might be explored.

Investigations that develop linkages among ecological, hydrological, climate, and socio-economic models in order to simulate current Amazônian ecosystem functioning also are desired. Such modeling research is expected to be an LBA-wide endeavor with contributions from all science components and most funded modules. Proposals for research to exercise, further develop, and/or couple existing ecological, hydrological, and socio-economic models as part of LBA-Ecology must address one or more of the questions enumerated in Section III-E.

All modeling proposals should describe how uncertainties in model results will be characterized and how the model will be validated. Ultimately, it will be the ability to model systems undergoing land-use change that will provide tools for both scientists and decision-makers to evaluate the potential consequences of different management practices, and to assess the consequences of policies that affect land-cover conversion. Thus, work to quantify uncertainties and validate models will be critically important in determining the utility of LBA modeling results and their successful application to sustainable development issues in Amazônia.

It is anticipated that LBA will develop close ties with existing and developing efforts in Earth System Modeling sponsored through the NASA MTPE research and analysis and the NASA EOS Interdisciplinary Science programs. LBA will link into the modeling activities of the IGBP GAIM, GCTE, IGAC, BAHC and LUCC Core Projects and coordinate with international model intercomparison activities, as appropriate.

NASA plans to fund approximately 4-6 new awards dedicated to modeling. It is expected that other proposals to be selected may include modeling as one component of a study focused on other research activities. In addition, individuals conducting on-going modeling research, e.g., EOS Interdisciplinary modeling, are encouraged to propose for participation in LBA-Ecology.

4. Remote Sensing. The LBA-Ecology science themes described in Section III-E pose questions that require satellite and airborne remote sensing data. Local, mesoscale, and Amazônia-wide geo-referenced maps of remote sensing-derived land surface, meteorological, and atmospheric properties will be produced: 1) to characterize the regional landscape and its dynamics over the time record of the satellite, 2) to help place the study sites in their correct bioclimatological and geographic context, 3) to provide local to regional scale, spatially continuous data and/or time series of data to drive and validate models, and 4) for scaling studies to integrate, interpolate, and/or extend knowledge gained at the plot level to regional scales.

Proposals are requested to provide the following basic satellite remote sensing data products: land cover type; biophysical properties of land cover; surface radiation and meteorological parameters; surface moisture properties; topography; fire location, timing, and extent; and atmospheric aerosol properties. In some cases, algorithm refinement or modification for tropical ecosystems will be a necessary first step. *All of these proposals must include a data management plan, a validation plan, and either a data analysis component focused on addressing one or more of the questions enumerated in Section III-E of this announcement or an explicit description of how it is expected that the data product will be used by other LBA-Ecology participants to address one or more of these questions.*

An important application of remote sensing in LBA-Ecology will be in the detection and quantification of varied aspects of land cover and land cover change. It is expected that the data and results from recent work by INPE and the Landsat Pathfinder program to quantify deforestation extent and rates in the Amazon will be made available for LBA. Research to provide one or more repeat analyses for the time period of the LBA-Ecology field work is desired, and it is hoped that these analyses can be continued by these same groups. Research on the following Amazônian land cover topics is of interest for LBA-Ecology: refined discrimination of Amazônian vegetation types; refined discrimination of agricultural cover types; correct classification or quantification of re-growth stages, age classes, or biomass densities; identification of areas experiencing selective logging and quantification of the biomass losses in them; and discrimination of the areal extent and duration of inundation in seasonally flooded forests.

Other topics of interest include: further development and testing of cloud screening and smoke effects removal algorithms; use of radar remote sensing (for applications more traditionally served by optical data) to avoid problems of cloud cover in the wet season and smoke in the dry season; development and/or refinement of algorithms to explore the interannual dynamics of land cover and land use change in Amazônia; and development of optical and microwave methods to monitor vegetation phenology. This list is not exhaustive, and there may be other promising applications; investigators are encouraged to propose and justify the significance of such research.

Research on new or yet unproven applications of remote sensing is desired if 1) the potential return to LBA science can be demonstrated as highly significant and 2) useful applications are achievable within the observational time-frame of LBA-Ecology. A number of promising research areas were identified in the Remote Sensing Workshop report (Hall et al., 1996). The following remote sensing applications are of particularly high priority because of their potential to fill key data gaps and reduce major scientific uncertainties in understanding of regional carbon balance and trace gas fluxes: 1) use of radar from satellite or aircraft or airborne profiling lidar for improved estimates of biomass and/or secondary growth stage in re-growing forests and selectively logged areas, 2) use of microwave data for improved estimates of the areal extent and duration of flooding in seasonally inundated forests and wetlands.

Proposals for new or yet unproven applications of remote sensing that are accepted will be selected for an initial 1-2 year feasibility study before being approved for full incorporation into LBA. Therefore, these proposals must include a section describing a schedule of activities for demonstrating feasibility. Proposers should expect to have the feasibility of their application reviewed by NASA, with assistance from the LBA-Ecology Science Team, after 1-2 years. If the research application is determined to be feasible and ready for implementation within LBA-Ecology, the award will be continued for the originally proposed duration, with annual reporting and internal review, and the work will be fully incorporated into LBA-Ecology. If the application is determined to be not feasible or not ready, the award will be allowed to expire at the end of the current performance period. If such research requires the use of NASA aircraft, feasibility must be demonstrated without a deployment to South America.

Satellites and/or sensors potentially available for LBA-Ecology research in the near-term, including several with historical time series, include Landsat, AVHRR, SPOT, ERS-1 & 2, JERS-1, Radarsat, SSM/I, GOES, IRS, and ADEOS. A variety of other data sets, such as the 1994 SIR-C coverage, may also be of value. New satellites and/or sensors that will become available after 1997 or 1998 include TRMM, EOS AM-1 (with MODIS, MISR, ASTER, and CERES), Landsat 7, CBERS, ENVISAT, and ADEOS II. Other possibilities for useful satellite data include the Lewis and Clark technology demonstration satellites, a variety of new high spatial resolution commercial sensors, and SRTM. Investigators planning to use satellite sensor data that will not be available until well into the second or third year of their investigation should either 1) take care to explain how the data can be used to address one or more of the questions enumerated in Section III-E of this announcement prior to the end of the initial 3 year performance period or 2) consider proposing preparatory research that either uses existing data or focuses on developing methods that can be used to address one or more of the questions enumerated in Section III-E of this announcement and waiting to propose the new sensor data analysis for the second phase of LBA-Ecology that will be competed in early 2000. *Investigators proposing satellite data analysis should take care to specify how their satellite data will be obtained and, if necessary, to include its purchase in their budget.* LBA or LBA-Ecology may obtain certain satellite data sets as core measurements to be provided to the Science Team, but the decisions as to which data sets will be acquired have not yet been made.

It is anticipated that observations from airborne remote sensing instruments will be desired for use in LBA-Ecology. There are significant uncertainties concerning if, and more importantly, when approval to deploy U.S. aircraft could be obtained from Brazil. Thus, proposals to conduct airborne investigations that require U.S. aircraft are not being solicited at this time. Rather, NASA is requesting information, for planning and informational purposes only, on what types of airborne

science on U.S. aircraft are of interest to the research community in the context of LBA-Ecology (see Section IV-D and Appendix B for more information). Airborne sensors potentially available for LBA-Ecology include AVIRIS, AIRSAR, ASAS, MAS, SLICER, and many more Principal Investigator controlled sensors (see acronym list in Appendix A). If permission is obtained to conduct a U.S. remote sensing aircraft campaign, then proposals will be requested at a future date for such investigations. If permission is not obtained, there will be no U.S. aircraft deployment as part of LBA-Ecology.

Proposals may be submitted for aircraft remote sensing investigations that utilize host country aircraft. Investigators proposing the use of airborne remote sensing instruments on host country aircraft should take care to justify their requirement in terms of the unique observational capabilities of the airborne sensor and the importance of its observations to answering one or more of the questions enumerated in Section III-E. These investigations will, of course, be subject to compliance with all host country laws and approval processes.

All proposals to use airborne sensors should discuss sensor performance assessment and calibration in conjunction with their validation plan. Section IV-D provides additional guidance on the use of aircraft in LBA-Ecology.

Research that proposes innovative ways to merge data from sensors operating in differing spectral, spatial, and/or temporal domains is especially desired. It is anticipated that the difficult questions being posed within LBA-Ecology will require data from remote sensing instruments with differing capabilities and from a variety of ancillary data sources as well. Data fusion and data assimilation approaches are encouraged.

NASA plans to fund approximately 10-12 new awards dedicated to satellite and airborne remote sensing. In addition, scientists conducting on-going remote sensing research, e.g., Pathfinder and EOS instrument team member research, are encouraged to propose for participation in LBA-Ecology.

5. Field Observations and Process Studies. A preliminary design for the *in situ* field research to be conducted under LBA-Ecology was developed in response to the Manaus Workshop Report (Cerri et al., 1995) and has been integrated into the overall LBA research strategy. It is presented in Appendix A. Investigators responding to this solicitation should propose field observations and process studies consistent with this preliminary field design, but should be aware that the selected Science Team for LBA-Ecology will have the opportunity to modify and the responsibility for finalizing it consistent with LBA-Ecology's primary science question. It is also possible that decisions yet to be made by other LBA sponsors/modules may affect the final LBA-Ecology study design as well.

Proposals are requested for field observations and process studies to investigate the effects of forest conversion on carbon storage and exchange, nutrient dynamics, and trace gas fluxes along the 2 LBA-Ecology transects. Sites for field measurements and process studies should incorporate the range of categories of human-driven land-use and land-cover change now occurring in Amazônia, climatic variation (i.e., perennially wet sites to those with a 6-month dry season), and the predominant soil types of Amazônia (i.e., Oxisol and Ultisol/Alfisol soil types) -- with due consideration of such data that might already exist. It is anticipated that the primary study sites will support a full complement of observations and process studies (including tower-based and chamber-based flux measurements, *in situ* observations of states, and manipulative

experiments). It will be important to measure the net ecosystem exchange (NEE) either continuously or near-continuously over significant portions of several growing seasons using tower-based eddy correlation. Proposals also are requested for studies at secondary and auxiliary sites to pursue selected subsets of observations and process studies needed to address LBA-Ecology goals. These studies must be carefully planned to fill critical gaps and to avoid duplication of past work. Field work at auxiliary sites not located along the 2 transects may be conducted, but it is not expected to be a major focus or a big resource driver for LBA-Ecology. *All of these proposals must include a data management plan and a data analysis component focused on addressing one or more of the questions enumerated in Section III-E of this announcement.*

Aircraft measurements of trace gas fluxes will be required. The Atmospheric Chemistry module of LBA is currently planning to propose a comprehensive set of these measurements during the intensive TRACE-B campaign under consideration for the wet season of either 2000 or 2001, pending successful implementation of an agreement between NASA and Brazil and obtaining all necessary host country approvals. Additional flux and/or concentration measurements for a few priority gases (i.e., CO_2, and possibly CH_4, oxides of nitrogen, or CO) using light aircraft are appropriate for LBA-Ecology to ensure more frequent sampling, and proposals for such measurements on host country aircraft are welcome (see Section IV-D below). *Any such proposals must include a data management plan and a data analysis component focused on addressing one or more of the questions enumerated in Section III-E of this announcement.* Proposals to conduct flux measurements on U.S. aircraft are not being sought at this time, but note the request for letters of interest in Section IV-D.

Investigators proposing to provide measurements that will be repeated across the field sites should be prepared to work with their fellow team members to develop standards and observational protocols, to regularly calibrate instruments, and to conduct instrument/measurement intercomparisons. This cooperation will be vital to ensure the quality and intercomparability of the data to be collected.

Specific study sites have not been selected yet. Final site selection decisions will be left to the selected Science Team and associated Project staff. Logistical and cost considerations will weigh heavily in the site selection, and a number of existing research sites and facilities, including several flux towers, are likely to be viable candidates for final site selection. These include the mesoscale catchment area in Rondônia and several existing flux towers along the transects. New tower sites will be established, too. Investigators are welcome to propose specific sites along the two transects or to express preferences as to where or at what type of site (e.g., primary forest, secondary forest, pasture, row-crop agriculture, Oxisol, Ultisol, eastern transect, western transect, etc.) they wish to work, but are encouraged to be as flexible as possible. Obviously, certain types of studies must be tied to specific sites; such research might include large-scale manipulations being conducted by others that could be exploited for LBA or chronosequences of land use where finding the right site(s) with appropriate historical data is critical. In such cases, proposals may be site specific.

NASA plans to fund approximately 12-15 awards to acquire new field data. Approximately equal levels of effort are anticipated for tower-based observations; ground-based observations and process studies surrounding the towers; and ground-based observations, process studies, and field experiments at secondary and auxiliary sites.

6. Case studies. Proposals for case studies and field investigations of changes in land use and land cover along the 2 transects and in other parts of Amazônia are requested. These studies will be carried out in conjunction with analysis of multi-temporal, high-resolution satellite data to gain insight into local-scale dynamics of deforestation, abandonment, and second-growth turnover. They should use data from census documents and from new surveys to define the parameters that control local land use strategies. In addition, analyses will be conducted to define the social, economic, and political factors and conditions that are creating these changes with the objective that predictive models could then be developed.

NASA plans to fund approximately 2-3 new case studies.

7. Synthesis and Integration. Modeling is a key tool for scaling and integration of scientific understanding, and will be used for this purpose in LBA-Ecology, but it is not the only approach. Analysis of relationships among GIS data layers, direct calculations based on areal extent of land cover types, and analysis of remote sensing imagery are other such approaches. Investigations that focus on synthesizing and distilling information to answer one or more of the questions enumerated in Section III-E will be essential to the success of LBA. Research proposals to quantify Amazônia-wide budgets and fluxes, to understand regional ecosystem function, to elucidate the important drivers of land use change at regional scales, and to assess the role of Amazônia in global processes are requested. It is anticipated that all modules of LBA will contribute to and collaborate in this area of synthetic and integrative research. *Quantification of uncertainties in these integrative studies will be essential.*

NASA plans to fund approximately 1-2 new awards dedicated to synthesis and integration of newly acquired data and results as a result of this announcement. It is expected that additional studies focused on modeling will contribute in this area in the first several years of LBA-Ecology. In addition, it is anticipated that when renewal proposals are requested in 2000, increased emphasis will be placed on synthesis and integration research, and opportunities will be created for several more awards in this area.

8. Training and Education. In addition to the research to provide a scientific basis for sustainable development in Amazônia, NASA's South American partners in the planning of LBA value the opportunity that this major interdisciplinary research program offers to enhance their internal research capacities. As indicated in Section V-C-2, below, Principal Investigators are expected to collaborate with Brazilian institutions. Amazônia is a very large region with very few environmental and global change scientists. Scientists at Amazônian institutions have many responsibilities, but limited resources. Capacity enhancement and training will be key to the involvement of these scientists and to the recruitment of students and technicians from the region, and are, therefore, explicit objectives for LBA.

It is important to highlight the fact that the people involved -- from Principal Investigators to technicians -- will be the critical factors for successful completion of LBA research tasks. Because of the scope and duration of LBA, it is unrealistic to assume the field program could be implemented without substantial involvement of local institutions and personnel. For many projects, the number and quality of host-country participants will govern whether the project reaches its objectives. A near-term goal of general LBA training and education activities is to increase the pool of potential participants in Amazônia and help these persons develop the necessary basic skills to engage in LBA research. A long-term goal is to leave in place a stronger environmental and global change research community that is better prepared to grapple with the

complex issues surrounding development in its region. NASA recognizes the necessity of investing in such training and educational activities in order to achieve NASA's objectives for LBA-Ecology. NASA also intends to pursue cooperation with IAI in advancing its LBA training and educational goals.

Due to the breadth of topics addressed -- from nutrient cycling processes to the drivers of land use change -- developing the specific capacity of host-country researchers will be addressed best within a specific investigation. Thus, each LBA-Ecology proposal should explicitly address how the investigation will contribute to training and education. Relevant activities might include recruiting/training students and technicians, developing and/or teaching short-courses on topics of relevance to LBA-Ecology, engaging in exchanges of scientists and students with host country institutions, and contributing to general skills enhancement programs to be organized by LBA or possibly IAI. Field investigators may find it worthwhile to learn Portuguese or Spanish.

It is expected that LBA-Ecology proposals will include training and education as one component of a study focused on another LBA science activity.

G. Non-Responsive Topics and Activities

A number of potentially relevant research topics and activities fall outside the scope of LBA-Ecology for one reason or another. Some of these are described below in order to provide guidance to prospective proposers.

Some research tasks relevant to LBA fall into areas to be supported either in whole or in part by other modules of LBA. These modules are currently in varying stages of development, and future opportunities for participation in these other modules are anticipated. Proposals in the Physical Climate component of LBA are not being sought through this NRA. Proposals to conduct research on surface water storage and movement and on hydrological processes in general are not being sought through this NRA -- except for some work focused on aquatic biogeochemistry. Proposals for non-ground based atmospheric chemistry studies are not being sought through this NRA -- except for some light aircraft-based measurement of fluxes and/or concentrations of carbon dioxide (and possibly CH_4, oxides of nitrogen, or CO). All such proposals will be non-responsive to this NRA and will not be considered.

The NASA LBA-Ecology Project Office will be arranging for logistical support and the installation of infrastructure, including a data management system (see Appendix B). Therefore, proposals for these types of support activities will be non-responsive to this NRA and will not be considered. Basic, theoretical remote sensing science, unless it meets the criteria outlined in Section III-F-4 will be non-responsive to this NRA and will not be considered. Such work should be proposed to the remote sensing science element of the NASA TE Program. For reasons of cost and schedule risk, development of new remote sensing instruments will be non-responsive to this NRA and will not be considered. In general, development of any new instruments will be non-responsive to this NRA and will not be considered. However, minor refinements or adaptations of existing instruments to operate in the Amazônian environment and/or in a more continuous mode are acceptable and even encouraged, provided costs are reasonable.

Proposals for the conduct of airborne research requiring the deployment of U.S. aircraft to South America will be considered non-responsive, as described in Sections III-F-4 and III-F-5 above and IV-D below. In addition, NASA will not take responsibility for deployment of non-U.S. aircraft

to South America; proposals for such deployments will be non-responsive to this NRA and will not be considered. (Investigators seeking to propose non-U.S., non-host country aircraft flights for LBA should be prepared to seek involvement in LBA through direct interactions between the two governments involved, as advised by the South American Coordinating Committee (SACC) for LBA.)

Certain ecological research topics and activities that are or could be made relevant to LBA's overall goals have been excluded from the LBA-Ecology plan and the overall LBA Concise Experimental Plan because their inclusion would have driven the cost and scope of LBA beyond what was deemed affordable by the identified sponsors. Such research would have high merit as an addition to LBA if additional funding sponsors could be found, but it is believed that the core LBA research described in the LBA Concise Plan can proceed without it. Examples of research topics and activities in this category are non-remote sensing studies of biodiversity; paleoecological investigations; and field carbon dioxide enrichment manipulations or other large-scale field manipulations focused on global climate change questions. All such proposals will be non-responsive to this NRA and will not be considered. While studies of the effects of biomass burning on carbon, nutrients, particulates, and trace gas fluxes, and of biomass burning as a land management practice, will be considered responsive, studies dedicated to study of the burning process itself (i.e., *in situ* observations of fires and fire plumes) will be non-responsive to this NRA and will not be considered.

IV. LBA-ECOLOGY: IMPLEMENTATION

A. LBA-Ecology Project Office

NASA Headquarters will establish a Project Office for LBA-Ecology. This Project Office will be responsible for day-to-day implementation of LBA-Ecology activities. This includes management and coordination of resources provided to meet the scientific objectives and overall coordination of project planning, schedules, and field operations. Staff associated with this office will bear the primary responsibility for developing the infrastructure for LBA-Ecology; providing logistical support for the field studies and intensive airborne campaigns; organizing meetings and workshops of the Science Team; and implementing a data handling and distribution system for use by the Science Team. Appendix B describes the overall management of LBA and the LBA-Ecology Project Office in greater detail.

The LBA-Ecology Project Manager and Project Scientist will be appointed by the NASA Headquarters Program Offices responsible for LBA-Ecology. The Project Manager will head the LBA-Ecology Project Office and will represent the LBA-Ecology module on the LBA Field Operations Sub-committee. The Project Scientist will serve as the leader of the LBA-Ecology Science Team and will be their primary interface with LBA-Ecology Project management. The Project Scientist will represent the LBA-Ecology module on the overall LBA Science Steering Group.

B. Science Team Membership

Investigators selected to conduct research under this announcement will become members of the LBA-Ecology Science Team. They will be expected to participate fully in all Science Team meetings and activities and to budget accordingly (see Appendix B). The LBA-Ecology Science

Team will determine its own structure and method for interactions among team members to achieve the goals of LBA-Ecology and to contribute to the overall goals of LBA.

The LBA-Ecology Science Team will bear the primary responsibility for the scientific content, direction, and priorities within LBA-Ecology. The Science Team will be responsible for finalizing the study design and research strategy; they will work with the Project Scientist and Project Office staff to prepare the final LBA-Ecology Experiment Plan, detailing the specific activities to be conducted during the execution of LBA-Ecology. Additional work to strategically focus and prioritize research activities will be required of the selected Science Team for LBA-Ecology. They must also be prepared to coordinate and integrate their research activities under LBA-Ecology with activities that will be conducted under the other modules of LBA.

The LBA-Ecology Science Team will be expected to contribute to the establishment of a data management, data sharing, and data protocol plan across all of LBA that is consistent with participating national and agency policies and which promotes the timely publication and dissemination of scientific results. Current NASA policy does not allow for any period of exclusive use by either an individual scientist or a Science Team. Further, NASA intends to pursue a practice of timely release (i.e., as soon as is reasonably possible) for public access to data within the overall LBA partnership. Ultimately, investigators selected in response to this LBA-Ecology NRA will be expected to comply with the data policies and practices established by LBA.

Investigators selected through this NRA to conduct land-cover and land-use change research also will become members of the new NASA Science Team for LCLUC. Investigators proposing to this science theme should budget for one additional Team Meeting per year to cover that responsibility as well as their LBA responsibilities. The priorities and functions of the LCLUC Science Team may be found in NRA-96-MTPE-03, also available on the Mission to Planet Earth Home Page, under the topic "MTPE Research Announcements," sub-topic "Past NASA Research Announcements."

Investigators interested in providing leadership in the early implementation of LBA-Ecology and assisting the Project Scientist are requested to indicate their interest on the cover page of the proposal. Those indicating such an interest may be called upon to help organize the first Science Team meeting and other preparatory activities.

C. Schedule and Priorities for LBA-Ecology

The current plan for LBA-Ecology is to select field sites, begin installing towers and field research facilities, and start *in situ* data collection in early 1998 or as soon thereafter as approvals have been granted by the host country. It is envisioned that some sites and measurement capabilities may be implemented earlier than others and that it might take 1-2 years to get all LBA-Ecology activities underway. In general, once a field study begins operations, it will be expected to continue in place for at least 3 years. Obviously there will be exceptions to this duration, depending on the type of work proposed, and opportunities for investigations to change sites, but a major goal for this study is to assemble a 3-5 year core data set to answer the research questions posed.

Initial non-field research will focus on work that synthesizes data and/or results from past studies, assembles priority satellite and ancillary data sets, and exercises relevant ecosystem models to improve the research design. Research activities such as these, that do not require new field data, will be initiated as soon as possible after the LBA-Ecology selection is announced.

As of this writing, the highest priority for early implementation and operational capability in the field will be placed on those investigations required to establish one tower cluster, with a full complement of ecological and biogeochemical process studies, on each transect and to establish a core of land cover and land use change investigations. Next in priority for the LBA-Ecology field activities will be establishing a robust complement of observational and process studies at secondary sites, conducting additional studies of the factors controlling land use change, and adding towers, with complementary process studies, to complete at least one transect. Next in priority would be to complete both transects and enhance, from the bare minimum, the extensive, auxiliary site measurements. Also of high priority will be getting in place the field investigations and atmospheric monitoring that must start a year in advance of the Atmospheric Chemistry module's TRACE-B airborne campaign so as to facilitate the planning and scheduling of that module.

Proposers to this announcement are advised to offer a six-year commitment to research within LBA-Ecology, but to only propose a detailed plan for 3 years of work, starting on or after December 1, 1997. Proposals for shorter periods are welcome. Annual progress reports, to be reviewed internally, will be required. NASA intends to request continuation proposals, to be subject to full external peer review, for a 3 year or less period of performance during 2001-2003. It is anticipated that many of the original investigations will be successfully renewed in 2001, but that there also will be some turnover, opportunities for new investigators to propose, and probably opportunities for new questions to be addressed. Annual reporting and internal review will be required during this second performance period as well. In addition, if the need arises, resources permit, and host country approvals can be obtained, NASA may open LBA-Ecology to new investigations, including those requiring deployment of U.S. aircraft, through other future research announcements.

The above plan and schedule are, of course, entirely dependent on the implementation of appropriate agreements between the U.S. and Brazil and on the receipt of any other required approvals from host countries.

D. Use of U.S. Aircraft

The process for obtaining approvals to fly foreign aircraft in Brazil, and potentially other South American countries, is lengthy and complex. It is not always certain that approvals will be granted -- especially for sensitive sites or certain types of sensors. Detailed information about the aircraft and their payloads is often required at least a year in advance, and many internal legal requirements must be addressed. For these reasons, research requiring non-Brazilian (or non-host country) aircraft is not being solicited at this time. However, research to make *in situ* or remote sensing observations utilizing host country aircraft may be proposed in response to this NRA. NASA intends to propose use of U.S. aircraft in LBA at a later date. Only after approval to proceed is granted by Brazil, would NASA request and fund research on U.S. aircraft for LBA-Ecology.

NASA is interested in receiving information about what types of airborne science to be conducted on U.S. aircraft platforms are of interest to the research community and might be proposed in response to a future announcement for LBA. Thus, letters describing interest in U.S. aircraft deployment(s) to South America for research relevant to the goals and objectives of LBA-Ecology are requested. Such expressions of interest should describe the scientific research that could be conducted, the instrument(s) to be used, the required U.S. aircraft platform(s), and the desired

timing for a deployment(s) to South America (see Appendix B for more information). The information received will be used for planning and informational purposes only. No commitments or awards will be made in response to these letters of interest. Letters of interest should follow the guidance provided in Sections III-F-4 and III-F-5 and Section VI of Appendix B.

In all cases, investigators proposing aircraft work are expected to comply with all host-country laws and recommended procedures.

V. GUIDANCE FOR PROPOSERS

A. Eligibility

Participation in this program is open to all categories of domestic and foreign organizations, including educational institutions, industry, non-profit institutions, NASA research centers, and other government agencies. Civil servants in U.S. government research laboratories are eligible to apply, but may not request civil service salary reimbursement. Participation by non-U.S. Principal Investigators is encouraged within the specific guidelines described in Appendix D, which include a no-exchange-of-funds provision.

B. Opportunities for Currently Funded Research Tasks

1. On-going Investigations in Amazônia and EOS Interdisciplinary Investigations. *Scientists who are already conducting research in Amazônia that is consistent with the goals and/or scope of LBA-Ecology are encouraged to propose in response to this announcement at no cost or at low cost (e.g., for travel funds to attend Science Team meetings or to facilitate collaborations) in order to become members of the Science Team and participate in its activities.* Such proposals may consist of a cover letter indicating the scientist's interest in LBA and describing the particular research tasks to be pursued, a copy of the proposal that has already been funded, and some indication that the proposed work is already funded and participation in LBA is acceptable to the funding sponsor. Host country collaborators and institutions should be named in the cover letter. A full, new proposal need not be written. Such proposals will be evaluated along with all other proposals submitted in response to this announcement, but in a special category (see Appendix B, Section VI). No-cost and low-cost proposals selected for funding will be awarded under the same general conditions as the other proposals solicited under this NRA; performance periods will be awarded to match the duration of the on-going investigation as long as they do not exceed an initial 3 year performance period.

EOS Interdisciplinary investigators conducting research in Amazônia or conducting modeling studies that could be enhanced through collaboration with LBA-Ecology are invited to propose in this same way for participation in LBA.

2. Satellite Instrument Team Members. Due to its timing and the nature of the data to be collected, LBA will provide a unique opportunity to combine a major field campaign with evaluation of the performance of and data products from several new satellite sensors. The airborne remote sensing campaign(s) that may be proposed at a future date, as well as some of the *in situ* and light aircraft-based observations that may occur throughout the duration of LBA, represent excellent opportunities for evaluation of data from EOS AM -1, Landsat 7, TRMM, or other new satellites.

Science team members for these instruments or others who are responsible for their evaluation are invited to consider using the LBA region as a test site and cooperating with LBA-Ecology as a means of evaluating algorithms and data products. This invitation is not to be construed as an opportunity to re-define the goals or experimental design of LBA, but rather as an opportunity to influence the details of the planning so as to maximize LBA's usefulness for new satellite data evaluation. LBA scientists, of course, will be most interested in making use of these new data sets to help answer the questions they have tackled.

The TRMM Project is already planning to contribute a TRMM field validation module to LBA, and TRMM scientists involved in the planning for this activity are likely to receive NASA sponsorship for participation in LBA through TRMM, and, therefore, need not propose in response to this opportunity. There are other opportunities for TRMM scientists to collaborate with LBA-Ecology, mainly in the areas of modeling and synthesis and integration of results.

Scientists interested in participating in LBA-Ecology for the purpose of satellite data evaluation are encouraged to propose in response to this announcement at no cost in order to become members of the LBA-Ecology Science Team. Such proposals should take the same form and will be selected for awards as specified in Section V-B-1 above. A full, new proposal need not be written.

C. Collaborations

1. General. Proposers are encouraged to develop appropriate collaborations of all kinds. Combinations of U.S. and international scientists are encouraged, as are collaborations among scientists from government, industry, and academia.

Joint, collaborative proposals are welcome, as are parallel proposals for complementary activities. Proposers are cautioned to not create so broad or diffuse a collaboration that reviewers cannot evaluate the proposal at a reasonable level of technical detail or understand its management plan. Proposers are encouraged to note linkages among proposals being submitted in parallel, but are cautioned to not create critical dependencies on other proposals such that each cannot be evaluated as a separable unit of research. There will be many opportunities to pursue additional collaborations once the LBA-Ecology Science Team is selected.

2. Host Country Collaborations. Brazilian law requires that scientists from outside of Brazil participating in expeditions within Brazil have a Brazilian counterpart. A Brazilian institution with recognized expertise in the research area must take responsibility for the participation of the foreign investigators. For this reason, as well the obvious importance of involving scientists with needed expertise and familiarity with the local environment, proposers are strongly encouraged to involve Brazilian and/or other host country collaborators (e.g., scientists, students, and technicians) in their responses to this announcement. *Proposers should provide evidence that they have taken appropriate measures to facilitate the involvement of their host country collaborators.*

Proposals without host country collaborations will be considered responsive to this announcement, but if accepted, will be accepted for a one year definition phase pending identification of a host country counterpart or some other arrangement acceptable to the host country. One of the planned responsibilities of the South American Coordinating Committee (SACC) for LBA is to help match foreign participants with appropriate host country collaborators. If, at the end of this one year definition phase, an acceptable collaboration has been identified, the award will be confirmed for an

execution phase under the same terms as proposals selected without a definition phase. If an acceptable collaboration has not been identified at the end of one year, the award will be allowed to expire at the end of its initial performance period.

Proposers are referred to the 1993 Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) publication on *International Cooperation: Scientific Expeditions* (CNPq, 1993) for further guidance on Brazilian laws concerning international scientific expeditions (see Appendix F for LBA Home Page URL). It is possible that the official agreements that NASA will pursue with Brazil may affect the details of how such collaborations are developed and recognized, but the specifics of such arrangements cannot be anticipated at this time. Discussions concerning the involvement of other Amazônian countries are at a very early stage. Investigators who propose to work in the Amazon outside of Brazil will be expected to comply with all host country requirements.

Compliance with all applicable host country laws, regulations, policies, and procedures will be required of all LBA participants.

D. Proposal Submission and Review

Proposals may be submitted at any time during the period ending at 4:30 pm, EDT, on June 11, 1997. All proposals will be evaluated through a peer review and a NASA management review process during June - September of 1997, and results will be announced as early as possible thereafter.

All prospective proposers are strongly encouraged to submit a letter of intent to propose to NASA in response to this announcement by 4:30 p.m., EDT, on April 30, 1997. This letter should contain a brief description of the research to be proposed and name any planned Co-Investigators and collaborators. *Proposers are encouraged to submit their letters of intent electronically following the instructions provided in Appendix G; if this is not possible, letters of intent may be provided through the mail or by facsimile.*

Proposals may be up to fifteen pages of text, single-spaced, with type no smaller than 12-pt., including abstract and references. A reasonable number of figures and tables may be appended in excess of this page limit. Also not included in this total are the cover page, management plan, data plan, cost plan, and brief curriculum vitae (1-2 pages each) for proposing investigators. Detailed information on proposal format and content is provided in Appendix B.

Proposals will be subjected to external peer review utilizing both mail and panel evaluations. No-cost and low-cost proposals that have already been subject to external peer review may only be presented to a panel for review. A NASA management review for technical and logistical feasibility and cost analysis (if funds are requested) also will be conducted. The evaluation criteria to be used are listed in Appendix B.

Proposals should request no more than 3 years of funding to start no sooner than December 1, 1997. Annual progress reports will be required for renewal during 1998-2000. Publication of results in the peer-reviewed literature is expected. Studies funded by other organizations may have slightly different durations. It is anticipated that NASA funding for LBA-Ecology will continue beyond 2000, but new proposals will be required.

A complete proposal schedule is given below:

Letter of Intent to Propose Due:	4:30 pm EDT, April 30, 1997
Proposals Due at NASA Headquarters:	4:30 pm EDT, June 11, 1997
Announcement of Final Selections:	October/November, 1997

Additional information is provided in Appendices A-G of this announcement.

Appendix A contains the preliminary study design for the science to be conducted under LBA-Ecology and references, acronyms, and definitions of terms for this entire announcement.

Appendix B contains information on the management and organizational structure for LBA and amendatory guidance to Appendix C (Instructions for Responding to NRA) which is applicable only to this NRA. It is very important that proposers read Appendix B carefully in order ensure that guidelines on proposal submission are followed and evaluation criteria are understood.

Appendix C contains general instructions for responding to NASA Research Announcements.

Appendix D contains instructions for foreign participation in this opportunity.

Appendix E contains examples of the required institutional declarations and the proposal cover page.

Appendix F provides the URL addresses for accessing world wide web home pages with information relevant to this NRA. If electronic access is not available to the prospective proposers, a paper copy of relevant reference(s) can be requested by calling (202) 358-3552 and leaving a voice mail message. Please leave your full name and address, including zip code, and your telephone number, including area code.

Appendix G provides instructions on how to submit letters of intent electronically.

Prospective investigators are urged to read the information in all of the Appendices carefully and to follow the specific guidelines therein carefully.

Identifier:	NRA-97-MTPE-02
Submit **Full Proposals** and Non-Electronic Letters of Intent to:	LBA-Ecology Code Y 400 Virginia Avenue, SW, Suite 700 Washington, DC 20024 USA FAX: (202) 554-3024 *(for letters of intent only!)*

For overnight mail delivery purposes only the recipient telephone number is (202) 544-2775.

Number of Copies Required: 12

Submit One Additional Copy: of **Foreign Proposals** to:	NASA Headquarters Office of External Relations Mission to Planet Earth Division Mail Code IY 300 E Street, SW Washington, DC 20546
Selecting Official:	Director, Science Division Office of Mission to Planet Earth
Obtain Additional Information from: (primary point of contact)	Dr. Diane E. Wickland Manager, Terrestrial Ecology Program Code YS NASA Headquarters 300 E Street, SW Washington, DC 20546 Telephone: (202) 358-0245 FAX: (202) 358-2771 Diane.Wickland@hq.nasa.gov
or, for Land Cover and Land Use Change Studies	Dr. Anthony C. Janetos Manager, Land Cover & Land Use Change Program Code YS NASA Headquarters 300 E Street, SW Washington, DC 20546 Telephone: (202) 358-0276 FAX: (202) 358-2771 Anthony.Janetos@hq.nasa.gov

Your interest and cooperation in participating in this opportunity are appreciated.

ORIGINAL SIGNED BY

William F. Townsend
Acting Associate Administrator for
Mission to Planet Earth

Enclosures:

Appendix A - Preliminary Field Study Design for LBA and References, Acronyms, and Definitions
Appendix B - Project Management and Amendatory Guidance to the General Guidelines Contained in Appendix C and Applicable Only to this NRA
Appendix C - Instructions for Responding to NASA Research Announcements
Appendix D - Guidelines for Foreign Participation
Appendix E - Required Declarations and Proposal Cover Page
Appendix F - Electronic Addresses
Appendix G - Instructions for Submitting Letters of Intent Electronically

APPENDIX A

PRELIMINARY FIELD STUDY DESIGN FOR LBA AND REFERENCES, ACRONYMS, AND DEFINITIONS

I. PRELIMINARY DESIGN FOR FIELD RESEARCH

Analysis of the Manaus Workshop Report (Cerri et al., 1995) and other planning reports for LBA has resulted in the *ad hoc* Steering Committee for the LBA-Ecology module sketching out a preliminary study design, primarily for new field observations and process studies. This design should not be considered final; it has been offered to facilitate continued planning across all components of LBA until such time as the officially selected Science Team for LBA-Ecology has been announced. This Science Team will have the task of fully developing and finalizing the design and producing a detailed experiment plan in coordination with the other modules of LBA. The preliminary design presented below places heavy emphasis on those aspects of the field design that require major investments of resources for infrastructure and drive the placement of intensive study sites since these aspects have been the most pressing to coordinate with the other modules of LBA.

A. Two Transects

Much of the research associated with LBA's ecological research program will be carried out along two transects in the Amazon where forest conversion or selective logging have been major factors in shaping the landscape. Both transects span land use intensity and climatic gradients.

One transect (hereafter referred to as the eastern transect) will run from near Brasilia in the south, north to the state of Pará , and then west to the central part of the state of Amazonas (see Figure 2). Rainfall at the western end of this transect is more than 2.5 m/yr and is relatively constant throughout the year, while it is about 1.5 m/yr on the southeastern end of the transect and seasonal in nature. The second transect (hereafter referred to as the western transect) will run from Acre or the northern part of the state of Rondônia towards the southeast to the central part of Mato Grosso. Rainfall at the northwestern end of this transect is about 2.2 m/yr, while it is about 1.2 m/yr at the southeastern end. All sites along this western transect experience some dry months.

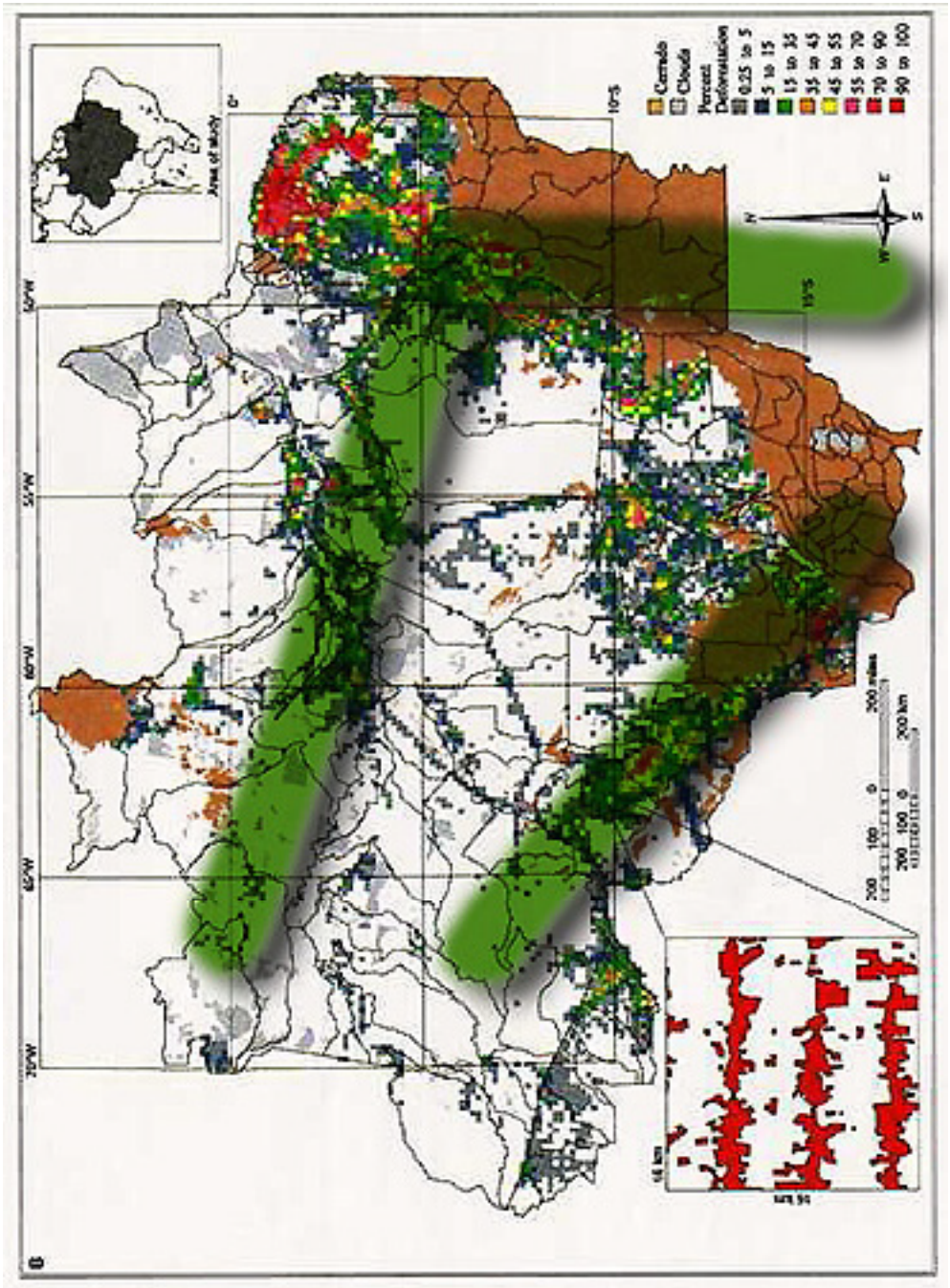
While examples of fertile and infertile soils can be found along both transects, infertile soils (mostly Oxisols) are probably more common along the eastern transect and relatively fertile soils (including Ultisols and Alfisols) play a more important role in areas undergoing land use change along the western transect. Insofar as it is possible, the primary research sites on the eastern transect will be located on the more infertile soils characteristic of the transect and the primary sites on the western transect will be located on more fertile soils.

Similarly, examples of very recent and somewhat older (20-30 years) land-use change can be found along both transects, but the eastern transect will probably provide more opportunities to study older land use changes.

B. Study Sites

1. Primary Study Sites: Towers and Catchments. Along the transects there will be a few primary and secondary research sites (at least 3 per transect -- one at each end and one near the middle) and more extensively distributed auxiliary research sites. The primary sites will anchor the transects. These sites will be based on clusters of 2-4 flux towers and, at least in one or two instances, catchments instrumented by other LBA modules for measurement of fluvial fluxes. The tower clusters were conceived to add a local-scale gradient of land use; they will include one tower in each of the major land use types of the area, keeping all other environmental variation at a minimum. A typical cluster might include towers in primary forest, pasture or crop land, and secondary forest, all on similar soils and within 50-100 km of each other.

Figure 2. This base map of the 1986 deforestation in the Brazilian Legal Amazon (Skole and Tucker, 1993) shows the location of the 2 LBA transects. The eastern transect will run from near Brasilia in the south, north to the state of Pará , and then west to the central part of the state of Amazonas. The western transect will run from Acre or the northern part of the state of Rondônia towards the southeast to the central part of Mato Grosso. These transects bisect the regions significantly affected by forest conversion. (Please note that LBA-Ecology is not to be restricted to only the Legal Amazon nor to just Brazil. Figure 1 shows the true region of interest.)



All LBA-Ecology towers will be instrumented to measure fluxes of water vapor, energy, and CO_2 -- and possibly CH_4 and oxides of nitrogen -- and will be operated on a continuous or near-continuous basis. Standard micrometeorological and ecological observations also will be made at these towers. It will be important that tower locations be carefully selected to avoid areas of urban atmospheric influence and anomalous soil, vegetation, and hydrological properties. Measurements of carbon and nutrient pools and fluxes and process studies will be conducted around the towers. Each tower site will be placed in the context of local land use practices, predominant environmental conditions, and local and mesoscale drainage basins.

2-6 of the LBA-Ecology towers (number and distribution among land uses and along the transects to be determined joint with the Atmospheric Chemistry module) will be enhanced to measure many other constituents, including ozone, carbon monoxide, NO_x, NO_y, non-methane hydrocarbons, reactive sulfur gases, and aerosol particles. These will be designated the "full chemistry," or "campaign chemistry," towers. These surface-based observations in support of the Atmospheric Chemistry module will focus on determining the fluxes and/or concentrations of key reactive and greenhouse gases and aerosols at surface sites in Amazônia and defining the primary influences on them. The suite of measurements also should include a range of indicator species for biomass burning (e.g. CO, acetylene) and industrial activity (CFCs, other halocarbons), along with key reactive species (NO_x, O_3), biogenic reactive hydrocarbons (isoprene), and greenhouse gases (CO_2, CH_4, N_2O). These enhanced tower-based observations will be taken for short periods of time (weeks or months) to coincide with the atmospheric chemistry campaign(s). Additional concentration observations may be made at secondary and auxiliary sites to constitute a regional monitoring network of flask sampling.

The overall LBA goal is to deploy 3 or 4 towers (or tower clusters) to span each of the two major transects. It is expected that towers will be put in place along the two transects by all LBA modules. The only way a full complement of towers can be deployed to adequately define the two transects will be though cooperation, coordination, and effective sharing of infrastructure across all modules of LBA. Thus, LBA-Ecology is currently planning to provide only a subset of the total number of flux towers. The highest priority will be to ensure that there is at least one tower cluster covering the major land use types on each transect.

Pará probably will be the general location of the first tower cluster along the eastern transect. This cluster will be made up of four towers, one in each of four cover types: a primary forest, a pasture, a second-growth forest derived from pasture, and a selective-logging site. Depending on the availability of funding and agreement by the Principal Investigator(s), extant tower sites along the eastern transect (such as those near Manaus and Brasilia) where CO_2, water, and energy fluxes are currently being measured may be augmented with instruments to measure fluxes of other gases. Also dependent on the availability of funds is a desire to pair the extant towers near Brasilia with a new tower in nearby row crop agriculture and to install a tower in primary, aseasonal forest at the far western end of the transect.

Rondônia will be the general location for the first tower cluster along the western transect. This cluster will be made up of three towers, one in each of three cover types; a primary forest, a pasture, and a second-growth forest derived from pasture. This cluster will be embedded within the Rondônia mesoscale catchment study area already identified as a strong candidate intensive study area by other modules of LBA. This area is the Greater Jamarí region of Rondônia comprised of the Jamarí, Jiparaná, and Candeias river basins. It is possible that existing towers in this region might meet the needs, or could be augmented to meet the needs, of LBA-Ecology.

Particular attention should be paid to water chemistry dynamics and trace gas fluxes along moisture gradients in this mesoscale catchment study area in order to complement the detailed hydrological studies in the region planned as part of the hydrological module(s) of LBA. Depending on the availability of funding and/or cost-sharing with other LBA partners, additional towers or tower clusters may be deployed in northwest Rondônia or Acre and central Mato Grosso.

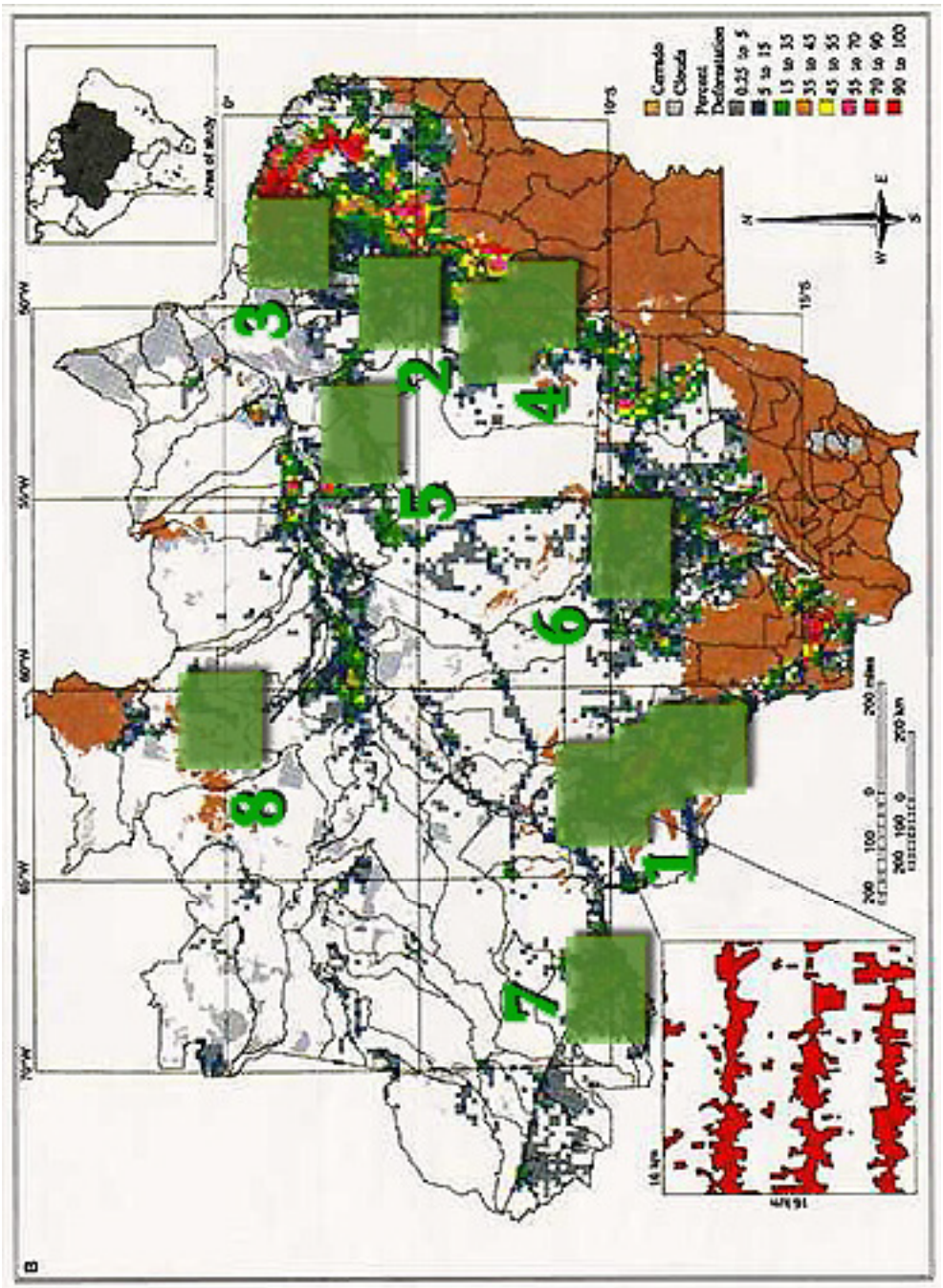
2. Secondary Study Sites. Additional field studies will be made at other sites along the two transects to extend the observational database beyond the tower cluster sites and to conduct detailed process studies and/or experimental manipulations. These extensive, secondary sites are needed to capture the full range of variation along the transects and to conduct research that could not be done at tower sites. These secondary sites will be used to characterize other forms of land use and management practice than those at the tower clusters; study chronosequences of land use; obtain additional samples for measurements of chemical concentrations and aerosols; assess processes on additional soil types, including those not being emphasized for tower site locations on the transect; and characterize processes along gradients from terre firme uplands through wetlands and riparian zones into streams and rivers. Measurements of carbon and nutrient pools and fluxes will be made at such sites. These measurements will include fluvial fluxes and gas evolution along moisture gradients.

Amazônia contains extensive permanent and seasonal wetlands which must be considered in the study design. Wetlands observations and process studies will be conducted at both primary and secondary study sites, where appropriate. The effects of selective logging in flooded forests is of interest, but for logistical reasons, it may not be possible to site a tower in flooded forest. If this is the case, attention must be directed toward resolving how best to characterize the role of these ecosystems and changes within them. It is possible that because of extensive past research, few new observations will be necessary in undisturbed wetlands.

Case studies and field investigations will be carried out to determine the local-scale dynamics of deforestation, abandonment, and second-growth turnover. These analyses will incorporate socio-economic (e.g., demographic and econometric) data to define the parameters that control local land use strategies and illustrate how changes in land use affect changes in land cover. It is anticipated that some of these studies may be conducted at sites that do not lie on one of the two transects in order to take best advantage of existing, scarce data sets on land use and its socioeconomic dimensions and to target areas of the most rapid land use change. A set of eight candidate sites (see Figure 3) was proposed during the planning for LBA.

3. Auxiliary Study Sites. One-time only field observations and survey data sets distributed extensively throughout the Amazon region (i.e., not necessarily along the two major transects) will be required to address some of the Amazônia-wide, regional research questions. Data from such auxiliary sites will be used to capture the full range of variation for key data types needed to drive models, characterize remotely sensed data sets, and conduct scaling studies. Auxiliary sites may be used to fill out a regional flask sampling network for aerosol and atmospheric chemical concentration measurements. Field work at auxiliary sites is not expected to be a major focus or a big resource driver for LBA-Ecology. Data to be obtained will be carefully selected to meet the most critical information needs for the regional studies. Other modules of LBA (e.g., Physical Climate) are expected to contribute many of the regionally extensive observations.

Figure 3. This map shows the locations for eight possible study sites for examining land-use and land-cover change superimposed upon the base map of 1996 deforestation in the Brazilian Legal Amazon (Skole and Tucker, 1993). All locations are in areas of rapid land-use change. These sites are only suggested candidates for research; other sites may be proposed. (Please note that LBA-Ecology is not to be restricted to only the Legal Amazon nor to just Brazil. Figure 1 shows the true region of interest.)



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III. ACRONYM LIST FOR ENTIRE NRA

ABLE - Atmospheric Boundary Layer Experiment
ADEOS - Advanced Earth Observing System (Japan, with U.S. & French collaboration)
AGE - Amazon Ground Emissions
AIRSAR - Airborne Synthetic Aperture Radar (aircraft instrument)
AM-1 - First morning-crossing EOS platform (U.S.)
AMBIACE - Amazon Biogeochemistry and Atmospheric Chemistry Experiment
ASAS - Advanced Solid-state Array Spectroradiometer (aircraft instrument)
ASTER - Advanced Spaceborne Thermal Emission and Reflection Radiometer (Japanese instrument on EOS AM-1)
ATSP - Automatic Tracking Sun Photometer (aircraft instrument)
AVHRR - Advanced Very High Resolution Radiometer (U.S.; on NOAA meteorological satellite)
AVIRIS - Airborne Visible-Infrared Imaging Spectrometer (aircraft instrument)
BAHC - Biospheric Aspects of the Hydrological Cycle (IGBP Core Project)
BATERISTA - Biosphere-Atmosphere Transfers and Ecological Research in Situ Studies in Amazônia
BOREAS - Boreal Ecosystem-Atmosphere Study
CBERS - China-Brazil Earth Resources Satellite (Brazil & China)
CD-ROM - Compact Disc - Read Only Memory
CENA - Centro de Energia Nuclear na Agricultura (Universidade de São Paulo)
CERES - Clouds and the Earth's Radiant Energy System (on EOS)
CPTEC - Centro de Previsão de Tempo e Estudos Climáticos (part of INPE)
DAAC - Distributed Active Archive Center (part of EOSDIS)
DMSP - Defense Meteorological Satellite Program (U.S.)
ENSO - El Niño - Southern Oscillation
ENVISAT - Environmental Satellite (Europe)
EOS - Earth Observing System (U.S.)
EOSDIS - Earth Observing System Data and Information System
ERS-1/2 - European Remote Sensing Satellites (Europe)
EDT - Eastern Daylight Time
EST - Eastern Standard Time
GAIM - Global Analysis, Interpretation and Modeling (IGBP Core Project)
GCM - General Circulation Model
GCTE - Global Change and Terrestrial Ecosystems (IGBP Core Project)
GIS - Geographic Information System
GOES - Geostationary Operational Environment Satellite (U.S.)
GTE - Global Tropospheric Experiment (NASA program)

IAI - Inter-Americas Institute for Global Change
IGAC - International Global Atmospheric Chemistry Project (IGBP Core Project)
IGBP - International Geosphere-Biosphere Programme
IHDP - International Human Dimensions Programme
IHP - International Hydrological Programme
INPA - Instituto Nacional de Pesquisas da Amazônia (Brazilian Amazonian Research Institute)
INPE - Instituto Nacional de Pesquisas Espaciais (Brazilian Space Research Institute)
IRS - Indian Remote Sensing Satellite (India)
JERS-1 - Japanese Earth Remote Sensing Satellite (Japan)
LAMBADA - Large-Scale Atmospheric Moisture Balance of Amazônia using Data Assimilation
LBA - Large-Scale Biosphere-Atmosphere Experiment in Amazônia
LCLUC - Land-Cover and Land-Use Change (NASA program)
LUCC - Land-Use and Land-Cover Change (joint IGBP/IHDP Core Project)
MAS - MODIS Airborne Simulator (aircraft instrument)
MISR - Multi-angle Imaging Spectroradiometer (on EOS AM-1)
MODIS - Moderate Resolution Imaging Spectroradiometer (on EOS AM-1)
MSS - Multispectral Scanner System on Landsat (U.S.)
MTPE - Mission to Planet Earth
NASA - U.S. National Aeronautics and Space Administration
NEE - Net Ecosystem Exchange
NOAA - U.S. National Oceanic and Atmospheric Administration
NRA - NASA Research Announcement
NSF - U.S. National Science Foundation
OIC - Organizing and Implementation Committee (for LBA)
ORNL - Oak Ridge National Laboratory (U.S. Department of Energy)
POLDER - Polarization and Directionality of Earth's Reflectance (French instrument on ADEOS)
PRC - Program Review Committee (for LBA)
Radarsat - Radar Satellite (Canada)
SACC - South American Coordinating Committee (for LBA)
SLICER - Scanning Lidar Imager of Canopies by Echo Recovery (aircraft instrument)
SMMR - Scanning Multispectral Microwave Radiometer (U.S.)
SPOT - Systéme Probatoire d'Observation de la Terre (France)
SRTM - Shuttle Radar Topography Mission (U.S.)
SSC - Science Steering Committee (for LBA)
SSM/I - Special Sensor Microwave/Imager (U.S.)
SSR - Brazilian Remote Sensing Satellite (in planning - multispectral, with 6 times daily repeat coverage)
TAHBIS - Tropical Atmosphere-Hydrosphere-Biosphere Integrated Study
TE - Terrestrial Ecology (NASA program)
TM - Thematic Mapper on Landsat (U.S.)
TRACE-A - Transport and Chemistry near the Equator - Atlantic
TRACE-B - Transport and Chemistry near the Equator - Brazil
TRMM - Tropical Rainfall Measuring Mission (U.S.-Japan)
URL - Uniform Resource Locator
USP - Universidade de São Paulo
WCRP - World Climate Research Programme

WFI - Wide Field Imager (new instrument on CBERS)

IV. DEFINITION OF TERMINOLOGY UNIQUE TO THIS NRA

Auxiliary Study Site: An LBA-Ecology study site that is not the subject of intensive research. It may or may not lie along one of the transects and will likely be subject to one-time only field observations, survey data collections, or routine monitoring.

LBA: Large-Scale Biosphere-Atmosphere Experiment in Amazônia. LBA is an international research initiative led by Brazil. LBA is designed to create the new knowledge needed to understand the climatological, ecological, biogeochemical, and hydrological functioning of Amazônia, the impact of land use change on these functions, and the interactions between Amazônia and the Earth system. It is much broader than, but wholly inclusive of, LBA-Ecology. It will be composed of a group of complementary research modules (see definition below), each with its own subset of goals and objectives and funding sponsor(s).

LBA Component: One of these 6 overall LBA research areas: Physical Climate, Carbon Storage and Exchange, Biogeochemistry, Atmospheric Chemistry, Land Surface Hydrology and Water Chemistry, and Land Use and Land Cover. (Note that these LBA components do not match one-to-one the LBA-Ecology Science Themes.)

LBA-Ecology: A program of research to be managed and funded by NASA that address the effects of tropical forest conversion, re-growth, and selective logging on carbon storage, nutrient dynamics, trace gas fluxes, and the prospect for sustainable land use in Amazônia. It includes the general areas of terrestrial carbon storage and exchange; nutrient dynamics; dynamics of surface water chemistry; trace gas fluxes; and land cover and land use change, including the human dimensions of land use change. Collectively, these general research areas constitute LBA-Ecology. LBA-Ecology is an LBA module that is being proposed by NASA to Brazil for inclusion in LBA. ("LBA-Ecology" will not be the final name of this study; its usage is to be limited to the purposes of this NRA.)

LBA-Ecology Activity: One of these 8 LBA-Ecology research activities: Synthesis of Past Work, Geographic Information System Development, Modeling, Remote Sensing, Field Observations and Process Studies, Synthesis and Integration, and Training and Education. These activities cross-cut the LBA-Ecology science themes (see definition below) and describe the types of work that must be done to address the science questions identified in each of the 5 LBA-Ecology science themes.

LBA-Ecology Science Theme: One of these 5 LBA Ecology science areas: land-cover and land-use change, carbon storage and exchange, nutrient dynamics, trace gas fluxes, and dynamics of surface water chemistry. These science themes are cross-cut by the LBA-Ecology activities (see definition above). (Note that these LBA-Ecology Science Themes do not match one-to-one the LBA Components.)

LBA Module: An independently funded and managed research program contributing to LBA. LBA will be implemented as a group of such complementary research "modules," each with its own set of goals and objectives and funding sponsor(s). A module may address one or more of

the LBA "components" and may focus on all or only part of the LBA research questions. LBA-Ecology is an LBA research module.

Primary Study Site: An LBA study area that includes a cluster of 2-4 flux towers instrumented for continuous or near-continuous observations of fluxes of water vapor, energy, and CO_2 -- and possibly CH_4 and oxides of nitrogen. The tower clusters within a primary study site cover a local-scale gradient of land use; a typical cluster might include towers in primary forest, pasture or crop land, and secondary forest, all on similar soils and within 50-100 km of each other. (Note that a primary study site is actually a small region.) Many additional *in situ* observations and process studies will be conducted within the primary study sites.

Secondary Study Site: An LBA-Ecology intensive study site along one of the 2 transects that is not part of an LBA-Ecology tower cluster. These sites will be used to extend the observational database beyond the tower clusters and to conduct additional detailed process studies and/or experimental manipulations to capture the full range of variation along the transects. Most case study sites will be secondary sites. Secondary sites might include a tower instrumented for simple flux measurements. (Note that a secondary study site may actually be a small region.)

APPENDIX B

AMENDATORY GUIDANCE TO THE GENERAL GUIDELINES CONTAINED IN APPENDIX C APPLICABLE ONLY TO THIS NRA: PROGRAM ORGANIZATION AND MANAGEMENT AND PROPOSAL CONTENT, SUBMISSION, AND EVALUATION INFORMATION

I. PURPOSE

These guidelines contain general and specific information regarding the submission of proposals in response to this NRA. Program organization and project structure are described. Formats for submission of proposals for research related to this program are provided. The evaluation criteria are specified. Appendix C contains general instructions for responding to NASA Research Announcements. Where conflicts exist between this Appendix and Appendix C, this appendix shall be the controlling document.

II. LBA PROJECT ORGANIZATION

The Large-Scale Biosphere-Atmosphere Experiment in Amazônia (LBA) is an international research initiative lead by Brazil. It is anticipated that a number of countries (e.g., Brazil, United States, other Amazônian countries, several European countries) will participate, bringing funding and other resources from a variety of national and international sources. In order to practically cope with such breadth of activities and diversity of support, LBA will be implemented as a group of complementary research modules each funded and managed by a different sponsor(s). Because of this, LBA will need an over-arching, umbrella structure to provide scientific integration and coordination at the highest levels. This umbrella organizational structure for LBA will be composed of four main committees.

A. South American Coordinating Committee

The committee with the lead responsibility for LBA is the South American Coordinating Committee (SACC). It will oversee the conduct of the overall LBA program and approve plans and implementation actions. It will ensure that any proposed activities under LBA are appropriate to the stated goals, and that they meet the requirements, both programmatic and legal, of working in the LBA campaigns. The SACC provides the highest level of interface with the cooperating governments in South America, and it will solicit the required approvals from these governments. It will consist of individuals from the host countries in South America, and it has the responsibility of appointing all other committees of LBA. This committee is planned to evolve out of a core Brazilian Coordinating Committee.

B. Organizing and Implementation Committee

The committee with the responsibility for implementing LBA is the Organizing and Implementation Committee (OIC). It will balance the operational needs, requirements, and scientific priorities with the available funding. The OIC will coordinate the major infrastructural needs and field operations of LBA, allocating resources to meet the overall priorities. It will direct a Field Operations Subcommittee charged with the day-to-day operations of LBA. In these tasks it will seek advice from, and provide advice to the Scientific Steering Committee (SSC) and SACC.

The members of the OIC are individually responsible to the funding bodies of LBA for the expenditure of funds and the implementation of priorities. As such its members will be nominated by the various agencies and countries funding LBA, and they will be appointed by the SACC. (By way of example, NASA intends to nominate the Managers of the Terrestrial Ecology Program and the Land Cover and Land Use Change Program to represent the LBA-Ecology module on the OIC.)

C. Science Steering Committee

The committee with the overall responsibility for scientific direction and strategies is the Science Steering Committee (SSC). It will develop scientific priorities and experiment plans for implementation in LBA, thereby guaranteeing scientific integration of the various components, and providing advice to the SACC. It also has a role in coordinating the scientific activities and direction of the components. Membership of the SSC will come from selected participants of LBA. Appointments will be made by the SACC, following nominations by responsible officials within each of the implementing sponsors. The chair of the SSC will be a one-year rotating position among the three major disciplines supporting the experiment (ecology, hydrometeorology, atmospheric chemistry). (By way of example, NASA intends to nominate the LBA-Ecology Project Scientist to the SSC and it is likely that one or more or the selected Science Team Members also may be nominated.)

The SSC will begin on an interim basis based on nominations from the current program managers and agencies supporting LBA. Its composition will be updated as selections of investigators are made through appropriate mechanisms in each country or region.

D. Program Review Committee

The Program Review Committee (PRC) will evaluate the overall integration of LBA and its performance in terms of meeting its stated objectives. It is anticipated that the PRC will meet twice. The first time, mid-way through the implementation of LBA, will be for the purpose of providing advice on possible mid-course corrections, and the second time, at the end of LBA, will be for the purpose of final program evaluation against the stated goals. Members will be nominated by the major international scientific research programs, e.g. the International Geosphere-Biosphere Programme (IGBP), the World Climate Research Programme (WCRP), the International Human Dimensions Programme (IHDP), the International Hydrology Programme (IHP), and the Inter-American Institute for Global Change Research (IAI), and appointed by the SACC.

E. Relationship Between LBA Project and LBA-Ecology Project

The overall umbrella organizational structure for LBA provides a means of coordinating and integrating LBA science and implementation activities. NASA intends to participate fully on the relevant LBA committees and seriously entertain their advice and recommendations while retaining full control over the NASA science selected for LBA-Ecology and the NASA resources expended within LBA. With the exception of the South American Coordinating Committee's (SACC) responsibility for host country approvals to conduct research within their borders, the overall LBA umbrella organization's role is that of communication, coordination, and integration across the modules of LBA. NASA is committed to building a strong, constructive partnership with the other sponsors of LBA.

III. MANAGEMENT STRUCTURE FOR LBA-ECOLOGY

This section provides information on the management structure and functions for the LBA-Ecology Project Office, which may be of relevance to the development and costing of research proposals.

A. Program Management

LBA-Ecology will be a research project within the NASA Terrestrial Ecology (TE) Program and the NASA Land Cover and Land Use Change (LCLUC) Program. Each program's resources will be managed separately, but they will provide and share a common Project Office. The NASA Headquarters TE and LCLUC Program Managers will serve as the Program Managers for their respective contributions to LBA-Ecology. They will provide the oversight necessary to ensure that the research activities of LBA-Ecology are in concert with the objectives of the NASA Office of MTPE and the research plans supporting this NRA. Both Program Managers will be the point(s) of contact for coordinating the research activities of LBA-Ecology with other collaborating U.S. and foreign agencies. They will be *ex officio* members of the LBA-Ecology Science Team and will be NASA nominees to the overall LBA Organizing and Implementing Committee .

B. Project Management

The Project Office for LBA-Ecology will be responsible for day-to-day implementation of LBA-Ecology. This includes management and coordination of resources provided to meet the scientific objectives; interaction with TE and LCLUC Program Managers and the Managers of other collaborating agency programs and science teams; and overall direction of project planning, schedules, and field operations. Staff associated this office will bear the primary responsibility for developing the infrastructure for LBA-Ecology, acquiring and reporting of specified baseline or core measurements in support of the study's goals; providing logistical support for the field studies and intensive airborne campaigns; organizing meetings and workshops of the Science Team; implementing a data handling and distribution system for use by the Science Team; and providing for the timely transmittal of all data collected by the project to the EOSDIS-designated public archive at the Oak Ridge National Laboratory (ORNL).

Certain observational facilities and project infrastructure (e.g., site preparation, towers, communications, field laboratory space) will be provided by the LBA Project either through coordination with the LBA Project Office now established at INPE in Brazil or directly through LBA-Ecology's Project Office. A series of baseline, or core, measurements and analyses may be provided by LBA-Ecology Project Staff; these measurements will be identified and prioritized in consultation with LBA-Ecology Science Team. They might include basic meteorological and climatological measurements derived from automated field instruments, satellite data acquisitions and initial processing, aircraft sensor observations and initial processing, meteorological measurements, or measurement and routine monitoring of selected surface characteristics. These plans to provide certain base measurements through Project Staff should not preclude anyone from proposing to provide them. When proposals for such measurements are received and accepted, the measurements will become the responsibility of the selected Principal Investigator.

The LBA-Ecology Project Manager will be appointed by the LBA-Ecology Program Managers to head the LBA-Ecology Project Office and coordinate the management of all the NASA Terrestrial Ecology and Land Cover and Land Use Change Programs' contributions to LBA. He/she will be responsible for all activities to implement LBA-Ecology. The LBA-Ecology Project Manager will work closely with NASA HQ and with the LBA-Ecology Science Team (often represented by the LBA-Ecology Project Scientist) in order to accomplish these responsibilities. The Project Manager will be nominated by NASA as a member of the Field Operations Sub-committee of the Organizing and Implementing Committee (OIC) and will serve as an *ex officio* member of the LBA-Ecology Science Team.

C. Science Team for LBA-Ecology

The Science Team for LBA-Ecology will consist of all investigators selected through this NRA and any subsequent LBA-Ecology research announcements. The term of participation on the Science Team will continue as long as the approved research continues. The LBA-Ecology Science Team will bear the primary responsibility for the scientific content, direction, and priorities within LBA-Ecology.

The Science Team will be chaired by the Project Scientist for LBA-Ecology who will be appointed by the LBA-Ecology Program Managers. The LBA-Ecology Project Scientist will be responsible for leading and organizing the LBA-Ecology Science Team and representing all scientific issues, priorities, and requirements to Program and Project Management. The Project Scientist will participate in the scientific discussions and decision-making for the ecological component of LBA in close collaboration with the Project Manager. He/she will be responsible for ensuring that NASA Program and Project management are fully informed of scientific results and accomplishments and will be expected to represent LBA-Ecology science in a variety of external fora. The LBA-Ecology Project Scientist will be nominated by NASA to serve as a member of the overall LBA Science Steering Committee.

The LBA-Ecology Science Team will determine its own organizational structure and method for interactions among team members to achieve the goals of LBA-Ecology and to contribute to the overall goals of LBA. For the first Science Team meeting(s), an organizational structure may be imposed to facilitate early interactions and decision-making. This imposed organizational structure may be adopted by the Science Team or abandoned as soon as the Science Team decides upon a preferred organizational structure.

Team members are expected to participate in LBA planning and implementation activities, to attend regularly scheduled LBA Science Team meetings and *ad hoc* workshops on special scientific issues as part of the LBA project, and to participate in data management activities. The Science Team will be responsible for finalizing the study design and research strategy. The Science Team will work with the Project Scientist and Project Office staff to prepare the final LBA-Ecology Experiment Plan, refining the preliminary study design and detailing the specific activities to be conducted during the execution of LBA-Ecology. The Science Team will be expected to contribute to the establishment of a data management, data sharing, and data protocol plan across all of LBA that is consistent with participating national and agency policies and which promotes the timely publication and dissemination of scientific results.

Participation in LBA-Ecology Science Team activities must be accounted for in each investigator's Cost Plan.

D. Data Management and Archive

A data management system will be created for LBA to provide for data and information management. It will cover already existing data and all the new satellite, aircraft, and ground-based data collected by the collective LBA Science Teams and Project staff. The details of how this data system will be organized and implemented are not yet fully defined. Almost certainly, there will data management work being conducted in Brazil at INPE's Centro de Previsão de Tempo e Estudos Climáticos (CPTEC) and at two or more locations in the U.S. LBA-Ecology will create its own component of the data management system and cooperate with the other modules to ensure an overall interoperable, cost-effective, useful data management system.

Timely and responsible sharing of data among all LBA participants will be essential to the success of the project. All data gathered under contributing initiatives to LBA will be made available to all other contributors to LBA as soon as possible under practices to be determined by the overall LBA Science Team. By the end of the project, and very likely much sooner, all data will be in the public domain. Data collection and handling for LBA will be subject to the arrangements made in the formal agreements enabling LBA and to all applicable host country laws and regulations.

LBA-Ecology's data management activities will provide Science Team members with a data system from which data for LBA-Ecology may be accessed and extracted and through which access to other LBA data is facilitated. Data management staff will be available to assist the Science Team with data quality assessment and documentation, the setting of common formats and standards (consistent with overall LBA procedures and NASA EOSDIS policies and procedures), and the distribution of data within LBA. Although data system staff will assist Science Team members in developing procedures and protocols for quality assurance and control of their data, the ultimate responsibility for the quality of the data will reside with the Principal Investigators. Participating scientists will be expected make their data available as soon as feasible (normally 3 to 6 months) following their measurements or model runs in order to facilitate data exchange and comparison within the LBA Science Team. In general, scientists who gather data will be required to make their own data available prior to requesting another investigator's data. Scientists making continuous or near-continuous observations in the field will be expected to process and deliver their data in parallel with their field activities in order to avoid long delays in the availability of their data to the Science Team. Scientists conducting integrative or modeling studies using the measurements of others will be expected to appropriately recognize their data source(s) and to submit agreed upon results, model code or algorithms, and model outputs to the data system in a timely fashion.

A database of LBA-relevant data collected during numerous previous research experiments in the Amazon is being created. This will facilitate preparatory modeling and synthesis studies and facilitate the extrapolation of LBA results beyond the LBA time-frame. Much of this data may be released on a CD-ROM in 1997. Individual data sets may be made available as they are ready through the LBA Home Page (at CPTEC) on the World Wide Web. Proposers are encouraged to check the mirror Home Page at ORNL periodically for any information that might be of use to them in developing their proposals. The URL addresses are listed in Appendix F.

The NASA EOS-designated long-term archive for ecological and biogeochemical data from field campaigns is the Distributed Active Archive Center (DAAC) at the Oak Ridge National Laboratory (ORNL). Thus, data collected through LBA-Ecology will be archived at the ORNL

DAAC. (It is possible that some of the LBA-Ecology data obtained in cooperation with the Atmospheric Chemistry module might be archived only at the NASA Langley Research Center DAAC.) The ORNL DAAC will be responsible for distributing LBA-Ecology data to the public. In the near-term, the ORNL DAAC will be providing public access to data sets being compiled for LBA-Ecology preparatory activities, a bibliography of relevant publications, and the mirror LBA Home Page. The URL addresses are listed in Appendix F.

IV. UNITED STATES - BRAZIL / SOUTH AMERICA COORDINATION

Scientists and managers from NASA and INPE have been involved in informal planning activities for LBA for over 5 years. Representatives of many other Brazilian organizations (notably the University of São Paulo and INPA) and, more recently, other South American countries have been fully involved as well. NASA and INPE have exchanged letters agreeing to begin the process of moving LBA into the implementation phase. INPE has agreed to take the lead to arrange for the formal recognition and approval of LBA by the Brazilian Government. An LBA Project Office has been established at INPE under the auspices of the Ministry of Science and Technology and the Brazilian Academy of Sciences. The LBA Project Office recently submitted the LBA-Ecology proposal for review by the Brazilian Government. NASA intends to enter into an agreement(s) with the Brazilian Government to formalize the scientific cooperation and secure the necessary approvals for conducting research under LBA-Ecology in Brazil; this agreement will cover all investigations selected through this announcement, including any non-U.S. investigations selected. Many of the activities and schedules discussed in the LBA-Ecology NRA are subject to the successful execution of this agreement and obtaining all other necessary approvals. NASA also will seek to obtain any other required agreements/approvals from other host countries, as advised by the SACC, for LBA-Ecology field work.

It is expected that other countries participating in LBA through opportunities outside of this announcement will pursue their own bi-lateral agreements with the South American host countries.

Each major sponsor of LBA will solicit and/or respond to proposals according to its own procedures and schedule. Thus, this NASA announcement does not represent the only possible avenue for participation in LBA. It is anticipated that, at a minimum, additional opportunities to participate will be made available by NASA, within Europe and Brazil, and possibly through the IAI. Scientists eligible to seek these other opportunities need not apply to this NRA to propose participation in LBA. However, successfully proposing and competing through a NASA open competition with full external peer review has in the past proven advantageous to international scientists in securing support from their own national funding organizations. NASA is committed to pursuing the fullest integration of science possible within LBA, and will seek appropriate interactions with scientists funded by other LBA sponsors to conduct research within the broad scientific scope of LBA-Ecology.

V. PROPOSAL CONTENT AND FORMAT

The content of the proposal should provide sufficient detail to enable a reviewer to assess the value of the proposed research, its relation to LBA-Ecology objectives, and the probability that the investigators will be able to accomplish the stated objectives within the requested resources and LBA-Ecology schedule. The technical part of the proposal should be limited to the equivalent of

15 pages of text, single-spaced, with type no smaller than 12 pt., including abstract and references. The cover page, table of contents, management plan, data plan, cost plan, and short resumes need not count in this total. Additional pertinent information may be added as appendices.

Each proposal should contain the following materials assembled in the order given.

A. Cover Letter

Each proposal should be prefaced by a cover letter signed by an official of the investigator's institution who is authorized to legally bind the organization to the proposal and its content (unless the signature appears on the proposal itself). The cover letter should refer to the LBA-Ecology Program.

B. Proposal Cover Page

The proposal cover page should contain the following: a short, descriptive title for the proposed effort; the name of the proposing organization(s); names, addresses, telephone numbers, FAX number, electronic mail addresses, and affiliations of the Principal Investigator and all Co-Investigators; and a year by year budget summary, including a total for all years. If the Principal Investigator is interested in playing a leadership role in the early planning, the area of interest should be indicated at the bottom of the cover page. An example cover page is provided in Appendix E.

C. Table of Contents (recommended length: 1 page)

A table of contents listing the page numbers for key sections of the proposal, including the data, management, and cost plans, should be provided.

D. Abstract and Technical Plan (not to exceed 15 pages)

The abstract should summarize the research proposed in one page or less. It should contain a simple, concise overview of the investigation, its objectives, its scientific approach, expected results, and the value of its results to LBA-Ecology. It is very important that this abstract be specific and accurately represent the research to be conducted.

The main body of the proposal should contain a full statement of the research to be undertaken and should describe objectives, scientific relevance, technical approach, and expected significance of the work. The key elements of the project should be clearly identified and related to each other. The methods or approaches to be used should be described, and, as appropriate, the advantages of the selected methods or approaches over alternatives should be discussed. The anticipated results should be identified and their relation to the proposal's stated objectives and the objectives of LBA-Ecology should be discussed. It is recommended, unless the investigators are proposing something very new or unusual, that any background, introductory, or general scientific justification sections be limited to a total of 1-2 pages so that the bulk of the proposal can be devoted to the actual work to be done for LBA-Ecology. However, proposals should be explicit in putting the proposed research into the context of what has already been done and is already known. Proposals should specifically address the importance of their work in filling major gaps and reducing major scientific uncertainties for LBA-Ecology. The research should be described in

sufficient detail that peer reviewers can adequately assess the scientific methods and quality of the work proposed.

A list of references used in the Technical Plan should be provided.

E. Data Plan (recommended length: 1/2 - 2 pages)

All proposals should provide a brief Data Plan describing the investigator's commitment to and plans for sharing data and for interacting with the LBA data management system(s). This plan should describe, in a general way, the data to be collected and how it will be handled, processed, quality checked, and made available to other LBA investigators. A rough data delivery schedule should be provided. Estimates of the type and amount of data to be requested from the data system and/or other investigators and the desired time of delivery should be described. *If data from other LBA investigations or core measurements to be obtained by Project Staff will be required, these measurements should be listed in the Data Plan. Resources (i.e., personnel and equipment) for supporting the Data Plan should be identified in the Cost Plan.*

F. Management Plan (recommended length: 1/2 - 3 pages, depending on complexity)

The Management Plan should outline the roles and responsibilities of all investigators and collaborators and indicate the relationships among these roles and responsibilities within the group. The management plan should also identify what contractor and/or non-institutional support is anticipated and who will be providing it. If the research proposed has the potential for any significant environmental impact, this potential should be stated in the Management Plan and plans to obtain appropriate approvals and/or mitigate effects should be described.

Training and educational activities that are not addressed in the technical plan should be addressed as part of the Management Plan.

If a remote sensing feasibility demonstration is required as part of the proposal, a schedule of activities for demonstrating feasibility should be provided as part of the Management Plan.

G. Cost Plan for U.S. Proposals Only (recommended length: 1 page per budget year, 1 budget summary page, 1/2 - 2 pages of explanation/justification, 1/2 - 2 pages detailing other funded projects)

A detailed cost plan must be provided. Costs should be broken down into all of the following categories that apply: salaries and wages, including staff-months and rates for all personnel; benefits; supplies; services; equipment purchases; satellite data purchases; computer services; publication costs; communications; travel; training and education, other; and overhead. Any unusual requests for funds (e.g., computer equipment, expensive equipment purchases) must be specially justified. *Budgets should be profiled to request 12 months of funding in fiscal year 1998 (FY98)with a start date of no earlier than December 1, 1997, and 12 months of funding in subsequent fiscal years for up to 3 years.*

The LBA-Ecology Project Office will provide logistical support to the selected Science Team and will work to efficiently provide field infrastructure and to seek economies of scale that will minimize costs. Needed logistical support and infrastructure must be described and budgeted for in individual proposals, but some or all of it may be pulled out post-selection for implementation

by Project Office staff. Proposers are urged to delineate these needs separately in their budget if at all possible. If difficulties arise in estimating costs for requested Project logistical and infrastructural support, proposers should at least describe their needs in sufficient detail that Project staff can evaluate the requirement. This same guidance should be followed if it is not possible to obtain an estimate of the cost for data from a future and/or foreign satellite sensor; volume/frequency of data, numbers of scenes required, or other such details should be specified. Selected scientists should expect to negotiate with the Project Manager to ensure that their infrastructural and logistical needs are met adequately and in a cost-effective manner.

Participation in LBA-Ecology Science Team activities, except for the first science team meeting, to be held in late 1997 or early 1998, must be accounted for in each investigator's Cost Plan. Investigators should budget for three four-day meetings in each of the first two years, nominally half in the U.S. and half in South America, and should budget for two four-day meetings per year in subsequent years. Investigators proposing under the land-cover and land-use theme should budget for one additional domestic trip per year to attend LCLUC Science Team meetings.

Contributions from any cost-sharing plan or other support for the proposed research should be detailed.

Current funding from other sources, including the level of funding and the title or brief description of the supported research, should be listed. If any of this other research is being conducted in Brazil and is relevant to LBA, the collaborating Brazilian institutions should be noted.

H. Resumes

Brief resumes (1-2 pages) for all named investigators should be appended to the proposal.

I. Declarations and Certifications

Certifications bearing official institutional signatures regarding drug-free workplace requirements, debarment and suspension, and lobbying must be appended. Example forms are provided in Appendix E.

J. Other Enclosures

Any other material pertinent to the consideration of the proposal may be attached as an Appendix. This might include preprints or reprints of relevant publications, background on new measurement or analysis approaches, or letters of support and/or participation by scientists and/or agencies in other countries. Inclusion of general materials that will not aid in the evaluation of the proposal is specifically discouraged.

VI. LETTERS OF INTEREST FOR U.S. AIRCRAFT DEPLOYMENT

Letters describing interest in and providing information about potential future U.S. aircraft deployment(s) to South America for research relevant to the goals and objectives of LBA-Ecology are requested. These letters should: 1) identify the interested scientists and their institutions, 2) describe the scientific research that would be conducted and its relevance to LBA, 3) identify the instrument(s) and U.S. aircraft platform(s) of interest, and 4) specify the desired timing for a

deployment(s) to South America. The information received will be used for planning and informational purposes only. No commitments or awards will be made in response to these letters of interest.

Letters of 1-2 pages in length should be adequate to provide the requested information. Brief descriptions of sensors and/or aircraft platforms may be appended, if appropriate. These letters should be sent to the same address and are due on the same date as the LBA-Ecology proposals. No letter of intent need be submitted in advance.

VII. SELECTION PROCESS AND EVALUATION CRITERIA

The goals of the proposal evaluation process will be to identify the best scientific approaches to meeting the goals and objectives of LBA-Ecology and to ensure that a balanced suite of measurement, process, analysis, modeling, and integrative studies is obtained. The criteria listed below will be used in evaluating individual proposals. These criteria supersede those listed in section 13 of Appendix C, and are of approximately equal importance.

1. The intrinsic merits of the investigation, including:

    (a) the overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.

    (b) the effectiveness of the investigation in building upon past research results, and the degree to which it focuses on filling major gaps and/or reducing critical scientific uncertainties.

    (c) the qualifications, capabilities, and relevant experience of the Principal Investigator and any Co-Investigators or collaborators as an indication of their ability to carry the investigation to a successful conclusion within the requested resources, including timely publication of peer-reviewed journal articles.

    (d) the ability and commitment of the investigator's institution to provide the necessary support to ensure that the investigation can be completed satisfactorily.

2. The relevance and responsiveness of the proposed research to the goals and objectives of NASA's Mission to Planet Earth research program and to the goals and objectives of LBA-Ecology, as described in the announcement, including:

    (a) the feasibility of accomplishing the stated scientific goals of the proposed investigation and answering one or more of the questions posed in the announcement.

    (b) the quality and appropriateness of the plans for training and education and for involving host country collaborators

3. The cost of the investigation including consideration of the realism and reasonableness of the proposed cost and the relationship of the proposed cost to available funds.

The review for LBA-Ecology will consist of letter reviews by international scientists with specialized technical expertise followed by an international scientific peer review panel. No-cost or low-cost proposals that have already been subject to external peer review may only be presented to a panel (i.e., there may be no mail review). All proposals also will be reviewed by NASA managers to identify any logistical, implementation, cost, and/or management concerns. A package of complementary proposals will be assembled from among the most meritorious proposals to provide for a balanced research program of observations, process studies, analyses, training and education, modeling, and integration according to the study design priorities enumerated in this announcement.

LBA-Ecology has been proposed as a NASA contribution to the international LBA research initiative led by Brazil. This proposal is currently under review by the Brazilian Government and a decision has not yet been made. If the proposal is approved, NASA intends to enter into an agreement with the Brazilian Government to formalize the scientific cooperation and secure other necessary approvals (i.e., for aircraft overflights) for conducting research under LBA-Ecology in Brazil. Therefore, the field activities and schedules discussed in this announcement are subject to the successful and timely execution of this agreement and obtaining all other necessary host country approvals. NASA intends to make a selection on schedule, however, depending on the status of the pending LBA-Ecology proposal to and agreement with Brazil, NASA reserves the right to delay the initiation of all research activities that must be conducted within Brazil beyond the target date of early 1998. This means that at the time of selection, of the proposals that NASA desires to select for LBA-Ecology, some will be selected and all activities funded; some may be selected and funded only for appropriate non-field, preparatory, or planning activities, with the field activities and funding put on hold pending approvals from Brazil; and some may be declined if approvals for the type activity in the proposal should have already been denied by Brazil. If delays are necessary for some of the research activities, NASA will confer with the affected organizations to mutually agree upon revised work plans, schedules, and budgets to provide for an appropriate preparatory study. Research activities involving work within Brazil will not be funded until such time as the official agreement with Brazil covering those activities is completed. NASA reserves the right to make no selections and no awards for those research activities that do not receive endorsement and approval from the Brazilian Government. Subject only to the appropriation of funds, NASA intends to make selections and awards for those research activities which do not require approval of the Brazilian Government, as well as for those research activities that receive endorsement and approval from the Brazilian Government. It should be noted that NASA has proposed LBA-Ecology to Brazil as an integrated package of research activities, and expects to have it approved as a whole (except, perhaps, for the airborne science which is subject to additional scrutiny and regulation), however, NASA cannot guarantee that this will be the case.

Proposals without host country collaborations may be accepted for a one year definition phase pending identification of a host country counterpart or some other arrangement acceptable to the host country. If, at the end of this one year definition phase, a collaboration acceptable to NASA and the SACC has been identified, the award will be confirmed for an execution phase under the same terms as proposals selected without a definition phase. If an acceptable collaboration has not been identified at the end of one year, the award will be allowed to expire at the end of its initial performance period.

Proposals for new or yet unproven applications of remote sensing may be selected for an initial 1-2 year feasibility study prior to being accepted for full incorporation into LBA. These studies will be reviewed by NASA management and the LBA-Ecology Science Team 1-2 years after selection to assess whether the approach is feasible and the research is ready to be implemented within LBA-Ecology. If the research application is determined to be feasible and ready for implementation within LBA-Ecology, the award will be continued for the originally proposed duration, with annual reporting and internal review, and the work will be fully incorporated into LBA-Ecology. If the application is determined to be not feasible or not ready, the award will be allowed to expire at the end of its current performance period.

NASA may desire to accept only a portion of a proposer's investigation, in which case the investigator will be given the opportunity to accept or decline such partial acceptance. In cases in which two or more proposals address similar problems and/or adopt similar approaches to data analysis, NASA may desire joint participation on the part of two or more proposers in a single project. If such overlap involves more than one funding organization, NASA and those organizations will confer and mutually agree to the disposition of those proposals. It also is possible that in order to select a balanced set of investigations, NASA may request that an investigation be moved from one type of site to another. Again, this will only be implemented with the agreement of the Principal Investigator.

APPENDIX C

INSTRUCTIONS FOR RESPONDING TO NASA RESEARCH ANNOUNCEMENTS (JUNE 1995)

1. Foreword

a. These instructions apply to NASA Research Announcements. The "NASA Research Announcement (NRA)" permits competitive selection of research projects in accordance with statute while preserving the traditional concepts and understandings associated with NASA sponsorship of research.

b. These instructions are Appendix I to 1870.203 of the NASA Federal Acquisition Regulation Supplement.

2. Policy

a. Proposals received in response to an NRA will be used only for evaluation purposes. NASA does not allow a proposal, the contents of which are not available without restriction from another source, or any unique ideas submitted in response to an NRA to be used as the basis of a solicitation or in negotiation with other organizations, nor is a pre-award synopsis published for individual proposals.

b. A solicited proposal that results in a NASA award becomes part of the record of that transaction and may be available to the public on specific request; however, information or material that NASA and the awardee mutually agree to be of a privileged nature will be held in confidence to the extent permitted by law, including the Freedom of Information Act.

3. Purpose

These instructions supplement documents identified as "NASA Research Announcements." The NRAs contain programmatic information and certain requirements which apply only to proposals prepared in response to that particular announcement. These instructions contain the general proposal preparation information which applies to responses to all NRAs.

4. Relationship to Award

a. A contract, grant, cooperative agreement, or other agreement may be used to accomplish an effort funded in response to an NRA. NASA will determine the appropriate instrument.

b. Grants are generally used to fund basic research in educational and nonprofit institutions, while research in other private sector organizations is accomplished under contract. Contracts resulting from NRAs are subject to the Federal Acquisition Regulation and the NASA FAR Supplement (NHB 5100.4). Any resultant grants or cooperative agreements will be awarded and administered in accordance with the NASA Grant and Cooperative Agreement Handbook (NHB 5800.1).

5. Conformance to Guidance

a. NASA does not have mandatory forms or formats for preparation of responses to NRAs; however, it is requested that proposals conform to the guidelines in these instructions. NASA may accept proposals without discussion; hence, proposals should initially be as complete as possible and be submitted on the proposers' most favorable terms.

b. In order to be considered responsive, a submission must, at a minimum, present a specific project within the areas delineated by the NRA; contain sufficient technical and cost information to permit a meaningful evaluation; be signed by an official authorized to legally bind the submitting organization; not merely offer to perform standard services or to just provide computer facilities or services; and not significantly duplicate a more specific current or pending NASA solicitation.

6. NRA-Specific Items

a. Several proposal submission items appear in the NRA itself. These include: the unique NRA identifier; when to submit proposals; where to send proposals; number of copies required; and sources for more information. Items included in these instructions may be supplemented by the NRA.

7. Proposal Contents

a. The following information is needed in all proposals in order to permit consideration in an objective manner. NRAs will generally specify topics for which additional information or greater detail is desirable. Each proposal copy shall contain all submitted material, including a copy of the transmittal letter if it contains substantive information.

b. **Transmittal Letter or Prefatory Material.** (1) The legal name and address of the organization and specific division or campus identification if part of a larger organization;

(2) A brief, scientifically valid project title intelligible to a scientifically literate reader and suitable for use in the public press;

(3) Type of organization: e.g., profit, nonprofit, educational, small business, minority, women-owned, etc.;

(4) Name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation;

(5) Identification of other organizations that are currently evaluating a proposal for the same efforts;

(6) Identification of the NRA, by number and title, to which the proposal is responding;

(7) Dollar amount requested , desired starting date, and duration of project;

(8) Date of submission; and

(9) Signature of a responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization (unless the signature appears on the proposal itself).

c. **Restriction on Use and Disclosure of Proposal Information**

Information contained in proposals is used for evaluation purposes only. Offerors or quoters should, in order to maximize protection of trade secrets or other information that is confidential or privileged, place the following notice on the title page of the proposal and specify the information subject to the notice by inserting appropriate identification, such as page numbers, in the notice. In any event, information contained in proposals will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

NOTICE

Restriction on Use and Disclosure of Proposal Information. The information (data) contained in [insert page numbers or other identification] of this proposal constitutes a trade secret and/or information that is commercial or

financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal the Government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agreement). This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

d. **Abstract.** Include a concise (200-300 word if not otherwise specified in the NRA) abstract describing the objective and the method of approach.

e. **Project Description.** (1) The main body of the proposal shall be a detailed statement of the work to be undertaken and should include objectives and expected significance; relation to the present state of knowledge; and relation to previous work done on the project and to related work in progress elsewhere. The statement should outline the plan of work, including the broad design of experiments to be undertaken and a description of experimental methods and procedures. The project description should address the evaluation factors in these instructions and any specific factors in the NRA. Any substantial collaboration with individuals not referred to in the budget or use of consultants should be described. Subcontracting significant portions of a research project is discouraged.

(2) When it is expected that the effort will require more than one year for completion, the proposal should cover the complete project to the extent that it can be reasonably anticipated. Principal emphasis should, of course, be on the first year of work, and the description should distinguish clearly between the first year's work and work planned for subsequent years.

f. **Management Approach.** For large or complex efforts involving interactions among numerous individuals or other organizations, plans for distribution of responsibilities and arrangements for ensuring a coordinated effort should be described. Intensive working relations with NASA field centers that are not logical inclusions elsewhere in the proposal should be described.

g. **Personnel.** The principal investigator is responsible for supervision of the work and participates in the conduct of the research regardless of whether or not compensated under the award. A short biographical sketch of the principal investigator, a list of principal publications and any exceptional qualifications should be included. Omit social security number and other personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants, together with information as to their level of academic attainment. Any special industry- university cooperative arrangements should be described.

h. **Facilities and Equipment.** (1) Describe available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any Government-owned facilities, industrial plant equipment, or special tooling that are proposed for use.

(2) Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative. Where such arrangements cannot be made, the proposal should so state. The need for items that typically can be used for research and non-research purposes should be explained.

I. **Proposed Costs.** (1) Proposals should contain cost and technical parts in one volume: do not use separate "confidential" salary pages. As applicable, include separate cost estimates for salaries and wages; fringe benefits; equipment; expendable materials and supplies; services; domestic and foreign travel; ADP expenses; publication or page charges; consultants; subcontracts; other miscellaneous identifiable direct costs; and indirect costs. List salaries and wages in appropriate organizational categories (e.g., principal investigator, other scientific and engineering professionals, graduate students, research assistants, and technicians and other non-professional personnel). Estimate all manpower data in terms of man-months or fractions of full-time.

(2) Explanatory notes should accompany the cost proposal to provide identification and estimated cost of major capital equipment items to be acquired; purpose and estimated number and lengths of trips planned; basis for indirect cost computation (including date of most recent negotiation and cognizant agency); and clarification of other items in the cost proposal that are not self- evident. List estimated expenses as yearly requirements by major work phases. (Standard Form 1411 may be used).

(3) Allowable costs are governed by FAR Part 31 and the NASA FAR Supplement Part 18-31 (and OMB Circulars A-21 for educational institutions and A-122 for nonprofit organizations).

j. **Security.** Proposals should not contain security classified material. If the research requires access to or may generate security classified information, the submitter will be required to comply with - Government security regulations.

k. **Current Support.** For other current projects being conducted by the principal investigator, provide title of project, sponsoring agency, and ending date.

l. **Special Matters.** (1) Include any required statements of environmental impact of the research, human subject or animal care provisions, conflict of interest, or on such other topics as may be required by the nature of the effort and current statutes, executive orders, or other current Government-wide guidelines.

(2) Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal. Identify the cognizant Government audit agency, inspection agency, and administrative contracting officer, when applicable.

8. Renewal Proposals

a. Renewal proposals for existing awards will be considered in the same manner as proposals for new endeavors. A renewal proposal should not repeat all of the information that was in the original proposal. The renewal proposal should refer to its predecessor, update the parts that are no longer current, and indicate what elements of the research are expected to be covered during the period for which support is desired. A description of any significant findings since the most recent progress report should be included. The renewal proposal should treat, in reasonable detail, the plans for the next period, contain a cost estimate, and otherwise adhere to these instructions.

b. NASA may renew an effort either through amendment of an existing contract or by a new award.

9. Length

Unless otherwise specified in the NRA, effort should be made to keep proposals as brief as possible, concentrating on substantive material. Few proposals need exceed 15-20 pages. Necessary detailed information, such as

reprints, should be included as attachments. A complete set of attachments is necessary for each copy of the proposal. As proposals are not returned, avoid use of "one-of-a-kind" attachments: their availability may be mentioned in the proposal.

10. Joint Proposals

a. Where multiple organizations are involved, the proposal may be submitted by only one of them. It should clearly describe the role to be played by the other organizations and indicate the legal and managerial arrangements contemplated. In other instances, simultaneous submission of related proposals from each organization might be appropriate, in which case parallel awards would be made.

b. Where a project of a cooperative nature with NASA is contemplated, describe the contributions expected from any participating NASA investigator and agency facilities or equipment which may be required. The proposal must be confined only to that which the proposing organization can commit itself. "Joint" proposals which specify the internal arrangements NASA will actually make are not acceptable as a means of establishing an agency commitment.

11. Late Proposals

A proposal or modification received after the date or dates specified in an NRA may be considered if the selecting official deems it to offer NASA a significant technical advantage or cost reduction.

12. Withdrawal

Proposals may be withdrawn by the proposer at any time. Offerors are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances which dictate termination of evaluation.

13. Evaluation Factors

a. Unless otherwise specified in the NRA, the principal elements (of approximately equal weight) considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit, and cost.

b. Evaluation of a proposal's relevance to NASA's objectives includes the consideration of the potential contribution of the effort to NASA's mission.

c. Evaluation of its intrinsic merit includes the consideration of the following factors, none of which is more important than any other:

(1) Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.

(2) Offeror's capabilities, related experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives.

(3) The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel critical in achieving the proposal objectives.

(4) Overall standing among similar proposals and/or evaluation against the state-of-the-art.

d. Evaluation of the cost of a proposed effort includes the realism and reasonableness of the proposed cost and the relationship of the proposed cost and available funds.

14. Evaluation Techniques

Selection decisions will be made following peer and/or scientific review of the proposals. Several evaluation techniques are regularly used within NASA. In all cases proposals are subject to scientific review by discipline specialists in the area of the proposal. Some proposals are reviewed entirely in-house, others are evaluated by a combination of in-house and selected external reviewers, while yet others are subject to the full external peer review technique (with due regard for conflict-of- interest and protection of proposal information), such as by mail or through assembled panels. The final decisions are made by a NASA selecting official. A proposal which is scientifically and programmatically meritorious, but not selected for award during its initial review, may be included in subsequent reviews unless the proposer requests otherwise.

15. Selection for Award

a. When a proposal is not selected for award, and the proposer has indicated that the proposal is not to be held over for subsequent reviews, the proposer will be notified. NASA will explain generally why the proposal was not selected. Proposers desiring additional information may contact the selecting official who will arrange a debriefing.

b. When a proposal is selected for award, negotiation and award will be handled by the procurement office in the funding installation. The proposal is used as the basis for negotiation. The contracting officer may request certain business data and may forward a model contract and other information which will be of use during the contract negotiation.

16. Cancellation of NRA

NASA reserves the right to make no awards under this NRA and to cancel this NRA. NASA assumes no liability for canceling the NRA or for anyone's failure to receive actual notice of cancellation. Cancellation may be followed by issuance and synopsis of a revised NRA, since amendment of an NRA is normally not permitted.

APPENDIX D

GUIDELINES FOR FOREIGN PARTICIPATION

NASA accepts proposals from entities located outside the U.S. in response to this NRA. Proposals from non-U.S. entities should not include a cost plan. Non-U.S. proposals, and U.S. Proposals that include non-U.S. participation, must be endorsed by the respective government agency or funding/sponsoring institution in the country from which the non-U.S. participant is proposing. Such endorsement should indicate the following points: (1) The proposal merits careful consideration by NASA; and (2) If the proposal is selected, sufficient funds will be made available by the sponsoring foreign agency to undertake the activity as proposed.

Proposals, along with the requested number of copies and Letter of Endorsement must be forwarded to NASA in time to arrive before the deadline established for this NRA. In addition, one copy of each of these documents should be sent to:

NASA Headquarters
Office of External Relations
Mission to Planet Earth Division
Mail Code IY
Washington, DC 20546
USA

Any materials sent by courier or express mail (e.g., Federal Express) should be sent to:

NASA Headquarters
Office of External Relations
Mission to Planet Earth Division
Mail Code IY
300 E Street, SW
Washington, DC 20024-3210

All proposals must be typewritten in English. All non-U.S. proposals will undergo the same evaluation and selection process as those originating in the U.S. Non-U.S. proposals and U.S. Proposals that include non-U.S. participation, must follow all other guidelines and requirements described in this NRA. Sponsoring non-U.S. agencies may, in exceptional situations, forward a proposal without endorsement to the above address, if review and endorsement are not possible before the announced closing date. In such cases, however, NASA's Mission To Planet Earth Division of the Office of External Relations should be advised when a decision on the endorsement is to be expected.

Successful and unsuccessful proposers will be contacted directly by the NASA Program Office coordinating the NRA. Copies of these letters will be sent to the sponsoring government agency.

APPENDIX E

EXAMPLES OF REQUIRED DECLARATIONS AND PROPOSAL COVER PAGE

Certification Regarding
Debarment, Suspension, and Other Responsibility Matters
Primary Covered Transactions

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 34 CFR Part 85, Section 85.510, Participant's responsibilities. The regulations were published as Part VII of the May 26, 1988 Federal Register (pages 19160-19211). Copies of the regulation may be obtained by contracting the U.S. Department of Education, Grants and Contracts Service, 400 Maryland Avenue, S.W. (Room 3633 GSA Regional Office Building No. 3), Washington, DC. 20202-4725, telephone (202) 732-2505.

(1) The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statues or commission of embezzlement theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

(2) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

_____

Organization Name PR/Award Number or Project Name

_____

Name and Title of Authorized Representative

_____

Signature Date

ED Form GCS-008 (REV.12/88)

Certification Regarding Drug-Free Workplace Requirements
Grantees Other Than Individuals

This certification is required by the regulations implementing the Drug-Free Workplace Act of 1988, 34 CFR Part 85, Subpart F. The regulations, published in the January 31, 1989 Federal Register, require certification by grantees, prior to award, that they will maintain a drug-free workplace. The certification set out below is a material representation of fact upon which reliance will be placed when the agency determines to award the grant. False certification or violation of the certification shall be grounds for suspension of payments, suspension or termination of grants, or government wide suspension or debarment (see 34 CFR Part 85, Sections 85.615 and 85.620).

This grantee certifies that it will provide a drug-free workplace by:

(a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;

(b) Establishing a drug-free awareness program to inform employees about -

(1) The dangers of drug abuse in the workplace;
(2) The grantee's policy of maintaining a drug-free workplace;
(3) Any available drug counseling, rehabilitation, and employee assistance programs, and
(4) The penalties that may be imposed upon employees for drug abuse violations in the workplace;

(c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a);

(d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the grant, the employee will -

(1) Abide by the terms of the statement; and
(2) Notify the employer of any criminal drug statute conviction for a violation occurring in the workplace no later than
five days after such conviction;

(e) Notifying the agency within ten days after receiving notice under subparagraph (d)(2) from an employee or otherwise receiving actual notice of such conviction;

(f) Taking one of the following actions, within 30 days of receiving notice under subparagraph (d)(2) , with respect to any employee who is so convicted -

(1) Taking appropriate personnel action against such an employee, up to and including termination; or
(2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved
for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency;

(g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraph (a), (b), (c), (e), and (f).

_____
Organization Name PR/Award Number or Project Name

_____
Name and Title of Authorized Representative

_____ _____
Signature Date

ED 80-0004

CERTIFICATION REGARDING LOBBYING

Certification for Contracts, Grants, Loans, and Cooperative Agreements.

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000, and not more than $100,000 for each such failure.

_____

Signature and Date

_____

Name and Title of Authorized Representative

_____

Organization Name

LBA-ECOLOGY: NRA-97-MTPE-02

Title: _____

Principal Investigator Name:_____

Department:_____

Institution: _____

Street/PO Box: _____

City: _____ State: _____ Zip: _____

Country: _____ E-mail: _____

Telephone: _____ Fax: _____

Co-Investigators:

Name	Institution	Telephone	Electronic Mail
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Budget:

1st Yr.: _____ 2nd Yr.: _____ 3rd Yr.: _____

Total: _____

Requested Start Date: _____ Requested Duration: _____

Interest in a leadership role: YES _____ NO _____ Category _____

(Category choices: Land Cover and Land Use, Carbon Storage and Exchange, Nutrient Cycling, Trace Gases, Dynamics of Surface Water Chemistry, Remote Sensing, Modeling, Data Sets and GIS, Synthesis and Integration, and Training and Education)

Authorizing Official: _____ _____ _____

(Name) (Institution) (Date)

APPENDIX F

ELECTRONIC ADDRESSES

The URL references listed below are available for on-line access via the following World Wide Web Home-Pages:

(1) NASA MTPE Home Page (this NRA, the Manaus Workshop Report, the Remote Sensing Workshop Report, the MTPE Science Plan):

http://www.hq.nasa.gov/office/mtpe/

(2) mirror of LBA Home Page at ORNL (for LBA Concise Experimental Plan and any preparatory data sets that may have been released, CNPq guidelines for foreign participation, etc.):

http://www-eosdis.ornl.gov/lba_cptec/

To minimize excess traffic at the INPE Home Page: if you are outside of South America., please use this mirror site primarily!

(3) LBA Home Page at CPTEC, INPE:

http://yabae.cptec.inpe.br/lba

(4) ORNL Amazon Home Page (for bibliography and a variety of background information, including a link to the mirror of the LBA Home Page):

http://www-eosdis.ornl.gov/LBA/misc_amazon.html

(5) EOS Project Science Office Home Page (for background on satellite missions):

http://eospso.gsfc.nasa.gov/

APPENDIX G

INSTRUCTIONS FOR SUBMITTING LETTERS OF INTENT ELECTRONICALLY

All prospective proposers are strongly encouraged to submit a letter of intent in response to this announcement. This will allow us to alert a peer review support staff to adequately cover the proposal review process. This letter of intent form is available electronically via the Internet at URL: *http://www.mtpe.hq.nasa.gov/LOI/form.html***.** The URL for the Co-Investigator (CoI) information is: *http://www.mtpe.hq.nasa.gov/LOI/coi.html.* We urge you to use these electronic letter of intent forms unless you do not have access to the Internet. In that case, we will accept a FAX copy sent to 202-554-3024 with the following information:

PI and CoI names and addresses (including Zip +4);

Title of proposal;

Telephone number;

FAX number;

E-mail address; and

A brief summary of what you plan to propose (please limit this to no more than 3000 characters).